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DEPARTMENT OF COMMERCE AND LABOR
BUREAU OF THE CENSUS
S. N. D. NORTH, DIRECTOR

SPECIAL REPORTS

CENTRAL ELECTRIC LIGHT AND POWER STATIONS
1902

PREPARED UNDER THE SUPERVISION OF WILLIAM M. STEUART
CHIEF STATISTICIAN FOR MANUFACTURES

WASHINGTON
GOVERNMENT PRINTING OFFICE
1905

C 3.222: 900/SPM/EL

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LETTER OF TRANSMITTAL.

DEPARTMENT OF COMMERCE AND LABOR,
BUREAU OF THE CENSUS,
Washington, D. C., September 1, 1905.

SIR:

I have the honor to transmit herewith a report on the central electric light and power stations of the United States for the year ending June 30, 1902. This report has been prepared in the Bureau of the Census, under the supervision of Mr. W. M. Steuart, chief statistician for manufactures, in accordance with the provisions of section 7 of the act of Congress of March 6, 1902.

This report is the third of a series of reports on the generation and utilization of electric current. The first related to street and electric railways; the second to municipal electric fire alarm and police patrol service, and was published as Census Bulletin 11; the fourth is now in course of preparation and relates to telephones, telegraphs, and ocean cables.

The data for this report were collected by the regular clerical force of the office and published November 30, 1903, as Census Bulletin 5.

The schedule of inquiry was formulated after consultation with experts and persons identified with the industry in different sections of the country, but the absence of a uniform system of accounting in central electric stations made it impossible to prepare a schedule that could be easily applied to the conditions prevailing in the different plants. Nevertheless, the canvass, as a whole, was satisfactory, and, with a few exceptions, complete returns were secured from all of the central electric stations that were in operation during any portion of the year.

The statistics do not include isolated electric light and power plants installed in manufacturing establishments, hotels, office buildings, etc., for the purpose of furnishing light and power primarily for the use of the individuals, firms, or corporations operating such establishments. The text of the report has been prepared by Mr. Thomas Commerford Martin, of New York city, expert special agent.

Very respectfully,

S. N. D. North

Director.

Hon. VICTOR H. METCALF,
Secretary of Commerce and Labor.

CENTRAL ELECTRIC LIGHT AND POWER STATIONS

30947—05——1

CENTRAL ELECTRIC LIGHT AND POWER STATIONS.

By THOMAS COMMERFORD MARTIN, Expert Special Agent.

CHAPTER I.

SCOPE AND METHOD OF INVESTIGATION.

Central electric light and power stations.—This report presents the statistics for all central electric light and power stations in operation in the United States during any portion of the year ending June 30, 1902. Central electric stations are plants owned or operated by individuals, companies, corporations, or municipalities and furnishing current for public or commercial uses. Some of the central stations generate current for sale at certain rates to the general public, the current being available to all within reach of the distributing mains; others, owned by municipalities, generate current only for municipal uses.

The commercial uses comprise the heating and lighting of private dwellings, hotels, business houses, and office buildings; the furnishing of power for the propulsion of electric motors attached to elevators, ventilating fans, etc., as well as those in factories and in other industrial establishments; and the supplying of current to railways for the operation of cars. The public uses relate more particularly to the lighting of streets, parks, docks, and municipal buildings.

In the collection and compilation of these statistics great care was taken to restrict the figures to central stations proper.

The term "station," while used throughout this report as a synonym for plant, is not strictly an equivalent, but is thus employed for purposes of convenience. In reality the station may comprise two or three, or even more, plants in a single city, and the tendency toward financial and physical consolidation makes it difficult to obtain figures that fairly represent the real growth in number. Some of the larger cities that reported only one or two stations had, as a matter of fact, several, all of which were capable of generating current, although but one or two were used as main sources of supply. For instance, at the time of this report the Edison Electric Company, of Los Angeles, Cal., although its plans were not fully consummated, was generating current in three mountain water plants and four steam plants in different localities with coal, oil, and natural gas as possible fuel. These seven plants, some of them miles apart, were connected by transmission lines, and all were included in one report, and therefore in these statistics they have been enumerated as one station.

Other sources of electric current.—Current is also generated in isolated plants, and some of these plants might be considered within the category of central stations, since, in addition to generating current for their own consumption, they have a surplusage that is disposed of to people in the vicinity. Such business, however, is done without a charter or franchise and requires virtually no ordinance; moreover, the wires rarely cross any thoroughfare, the supply of current not being available to the public generally. Such plants have been excluded from the scope of the present inquiry, although incidental reference will from time to time be made to the work of these plants. In fact, no statistics of isolated plants are included in this report, which, to that extent, therefore, falls short of embracing the entire electric light and power industry of the United States. Many of these isolated plants are of a very extensive and important character, being supplied with the most improved apparatus and giving facilities equal to those furnished to populous communities. It is estimated that there are 50,000 of these plants, and that they consume at least half the product in some lines of electric apparatus. A great many of these isolated plants, moreover, have connections with the mains of electric light stations, so that they can avail themselves of the supply of central station current should the necessity to do so arise.

Another source of supply of current for electric light and power purposes is that to be found in electric railway plants, the statistics for which are presented in the Report on Street and Electric Railways. Reference will be made to the figures for such plants, although they are not included in the present report. At the time of the collection of the statistics presented herewith, less than 4 per cent of the plants generating and distributing current for light and power purposes were operated in connection with electric railways.

There is a steady tendency toward the consolidation of electric lighting and other industrial enterprises, especially gas plants, waterworks, ice plants, and electric railways, where the systems happen to be of such size that economy can be effected by putting them under one management. In the case of such composite stations the statistics presented in this report relate only to the generation of electric current by them; if book accounts were not available for exact information concerning the operation of the electric station as distinct from other business, careful estimates were prepared for the answer to each of the inquiries.

Recent origin of the industry.—While electric arc lamps were known experimentally during the early half of the last century, they were not used commercially until 1876, and then only to a limited extent. The first central electric light station furnishing current to such lamps was not installed until 1879. The incandescent lamp industry may be said to have been virtually nonexistent in 1880, as the lamps were not introduced commercially until about that time, and the first central station supplying current to such lamps did not go into operation until 1882; although it is recorded that some incandescent lamps had already been operated tentatively on arc lighting circuits.

It is indeed an interesting and extraordinary feature of electric lighting development that the two branches of the industry, arc lighting and incandescent lighting, should have grown up and developed for several years separately and quite independently. Indeed, the earlier years of the industry were marked by a hostility between the two kinds of plants which was sometimes even ferocious in its nature, but which was soon found to be due to intense commercial rivalry rather than to any inherent incompatibility of a technical description. The period up to 1890, while marked by a vigorous and rapid extension of electric lighting, still witnessed a great deal of experimental and unsuccessful work and, as a result of the fact that separate apparatus was used for different classes of current generation and service, the expenses of operation were abnormally high, even in stations in which the arc and incandescent systems had been consolidated. In fact it may be questioned whether, had the two classes of lighting remained independent and rival enterprises, the industry as a whole could have made the remarkable advances that have been apparent since the methods were worked out and perfected which enable one source of current supply to feed from the same dynamos apparatus of the most varied and heterogeneous nature—arc lamps, incandescent lamps, stationary motors, railway motors, electric fans, electric heaters, plating baths, etc.

Effect of recent discoveries.—In view of the recent discoveries in the electrical field and the revolutionary improvements made in many classes of apparatus, it is obvious that a new industry is being dealt with, where statistics can not be quoted quite so confidently as those of an industry running back through centuries and subject to a slow evolution, the processes of which had been watched by generations of keen observers. Nevertheless it seems fair to assert that in electric light and power development the growth has been at a rate of unusual acceleration, so that even in so short a period as a quarter of a century the foundations of a stable and permanent industry have been deeply laid. Even if the period prior to 1890 was of a formative character, the inventions and improvements of the last ten years have been such as to lead some critics to suggest that in certain lines the limits of possible perfection have already been reached. The figures of the next census, therefore, while they may still exhibit a high percentage of increase and will certainly include the statistics for many novel appliances not now recorded as within the scope of the central station equipment, may possibly be found in many respects to exhibit an orderly sequence and a definiteness of function such as is always expected in a well-established industry.

It is to be observed in this connection that whereas in 1880 and in 1890 the area of central station current supply was strictly limited so that each station, like a gas plant, was able to supply only a narrow region at comparatively low pressures, at the present time, in many sections, the rural as well as the urban portions of the country are being covered by a network of electric circuits, and a few stations embrace in their operation whole counties and even larger districts. This work of electric transmission is apparently capable of indefinite extension, but the inference is justified that the broad basis and ultimate lines of operation have now been indicated in practice, subject to later filling in and solidification, very much in the same manner as the trunk railroads have been laid out and built up, to which other systems and even the wonderful network of rural trolley lines serve but as auxiliaries and feeders.

Period covered.—The statistics, as a rule, cover the twelve months ending June 30, 1902, but in some instances the reports are for the calendar year 1901 or 1902, and in a considerable number of cases for other periods of twelve months. Stations in operation during any part of the year are included. There were 141 private stations and 38 municipal stations that reported for a period of less than a year. Nearly all of these stations were just beginning operations, although in a few instances stations were in operation during the entire

year, but on account of changes in ownership, reports could be secured for a part of the year only. Since a very large proportion of these stations are located in small towns and villages, where the plants are not extensive, this inclusion does not materially affect the totals. Stations that were under construction and those that had not begun operations are not included.

Special agents of the Bureau visited the officials of every station to secure the returns. In almost all cases full and complete answers to the inquiries were given. However, in some instances the agents, in conjunction with the officials, found it necessary to make estimates where accurate reports had not been kept.

In the appendix will be found a copy of the schedule used in this investigation and also a copy of the instructions to special agents securing the returns.

Basis of classification of stations.—The conditions under which the different stations are operated and the miscellaneous character of the service which they are called upon to furnish are so varied that in presenting the statistics it has been deemed advisable to group together, so far as possible, those stations which operate under similar conditions, in order that the results may be studied and analyzed. Therefore, the stations have been divided into those operated by individuals and corporations and those operated under municipal control, and subdivided into those doing a purely electric business and those operated in connection with other industries. For convenience, the latter are designated composite stations.

Further subdivisions have been made, one being based upon the population of the place in which the station is located and the other upon the horsepower capacity of the generating apparatus of the station.

Classification according to population.—Central electric stations are divided according to population into the following groups:

1. Stations in places having a population of less than 5,000.
2. Stations in places having a population of 5,000 but less than 25,000.
3. Stations in places having a population of 25,000 but less than 100,000.
4. Stations in places having a population of 100,000 but less than 500,000.
5. Stations in places having a population of 500,000 and over.

In a majority of cases the service furnished by stations is limited practically to the territory of the municipalities in which they are found, yet many stations supply current for light and power to a number of cities and towns besides those in which they are located. It is believed that in general the size of the place has a great influence on the size of the plant, the rate of wages paid, and the price received for the current.

Classification according to dynamo capacity.—The classification, based on the horsepower capacity of the generating apparatus, is as follows:

1. Stations having dynamos with a horsepower capacity of less than 200.
2. Stations having dynamos with a horsepower capacity of 200 but less than 500.
3. Stations having dynamos with a horsepower capacity of 500 but less than 1,000.
4. Stations having dynamos with a horsepower capacity of 1,000 but less than 2,000.
5. Stations having dynamos with a horsepower capacity of 2,000 but less than 5,000.
6. Stations having dynamos with a horsepower capacity of 5,000 and over.

While many of the stations have generating equipment in excess of their present needs, it is believed that this classification furnishes data as to the economy of the operation of plants of different sizes, inasmuch as on the size of the plant depend largely the cost of construction and equipment, the number of wage-earners employed, the amount and cost of supplies, materials, and fuel needed, and the "load" under which the machinery is operated.

CHAPTER II.

SUMMARY AND ANALYSIS OF RESULTS.

General totals.—The magnitude of the industry in 1902 is shown by the statistics in Table 66, which presents the leading items by states. The totals for all stations and for private and municipal stations, respectively, are summarized in the following table:

TABLE 1.—*Central electric stations: 1902.*

	Total.	Private stations.	Municipal stations.
Number of stations	3,620	2,805	815
Cost of construction and equipment	$504,740,352	$482,719,879	$22,020,473
Gross income	$85,700,605	$78,735,500	[1] $6,965,105
Income from sale of current	$84,186,605	$77,349,749	[1] $6,836,856
Income from all other sources	$1,514,000	$1,385,751	$128,249
Total expenses	$68,081,375	$62,835,388	$5,245,987
Salaried officials and clerks:			
Number	6,996	6,046	950
Salaries	$5,663,580	$5,206,199	$457,381
Wage-earners:			
Average number	23,330	20,863	2,467
Wages	$14,983,112	$13,560,771	$1,422,341
Power plant equipment: [2]			
Steam engines—			
Number	5,930	4,870	1,060
Horsepower	1,379,941	1,232,923	147,018
Water wheels—			
Number	1,390	1,308	82
Horsepower	438,472	427,254	11,218
Generating plant equipment:			
Dynamos—			
Direct current, constant voltage—			
Number	3,823	3,405	418
Horsepower	442,446	418,913	23,533
Direct current, constant amperage—			
Number	3,539	2,957	582
Horsepower	196,531	157,768	37,763
Alternating and polyphase current—			
Number	5,122	4,300	822
Horsepower	987,003	896,315	90,688
Output of stations in kilowatt hours, total for year	2,507,051,115	2,311,146,676	195,904,439
Total number of arc lamps	385,698	334,903	50,795
Total number of incandescent lamps	18,194,044	16,616,593	1,577,451

[1] Includes estimated income from public lighting.
[2] In addition there were gas engines and auxiliary steam engines with a capacity of 26,635 horsepower.

The statistics are summarized in Table 1 so as to show the totals for the entire industry and of the plants controlled by private and municipal ownership, respectively. The details are given in subsequent tables. The kilowatt hour, for which totals are given in the above table, is the universal basis of computation with regard to the output and payment for current. Although the flat rate is still largely used, it is based upon an arbitrary assumption of a given amount of current being supplied in a specified time.

Isolated and railway plants.—In addition to these grand totals of the industry, other figures should be taken into consideration in order to arrive at the real extent of the central-station supply systems of the country. As already noted, a few isolated plants, out of the 50,000 estimated to be in operation in the United States, do some actual business in the way of selling current and giving general service, but no canvass was made to elicit the details; and, moreover, the figures for this part of the industry would be insignificant in comparison with the totals. During the year 1902, there were 253 electric railway companies that reported income received from the sale of current for light and power, and the companies selling current for such purposes are increasing in number. Of the 253 companies, 118 reported the number of lamps in use and the amount of income from the sale of current. The statistics for these companies are shown in Tables 97 and 98. If the statistics from this group be added to those already cited in Table 1, the number of stations would be increased to 3,738; the total income from the sale of current to $90,458,420; the number of arc lamps to 419,561; and the number of incandescent lamps to 19,636,729. For detailed statistics of the power and generating equipment of these plants, reference should be made to the Report on Street and Electric Railways. The subject will, however, be taken up incidentally under various headings in the present report.

Comparison of the statistics of private and municipal stations.—According to Table 1, private stations form by far the largest portion of the industry, constituting 77.5 per cent of the total number of stations in operation during 1902. Their income from sale of current formed 91.9 per cent of gross income, the expenses of operation 92.3 per cent of the total, while they gave employment to 89.4 per cent of the total number of wage-earners engaged in the industry and paid 90.5 per cent of the total amount of annual wages. The primary power plant equipment of these stations formed 91.3 per cent of the total horsepower of all stations, while their generating equipment formed 90.6 per cent of the total horsepower of all dynamos. The kilowatt hour output of private stations formed 92.2 per cent of the total, and the arc lamps in such stations formed 86.8 per cent of the total number wired for operation.

The comparison of the income of the two classes of stations is not a fair indication of their earning capacity, because of the gross income reported for municipal stations. Of this gross income, $6,836,856 resulted from the sale of current and included income from public service which was necessarily largely, if not wholly, a matter of estimation, as a municipal plant can scarcely be said to charge itself a rate for the work done. The estimated income is, therefore, the amount that presumably would

have been paid for the service had it been supplied by a private enterprise or, in other words, the amount that would have been paid by a private customer taking such service from the municipal plant. In cases where it was necessary to determine this item of income from public service, the effort was made to bring such figures into harmonious relation with those applying elsewhere in the state or section, so as to make them reasonable and consistent with prevalent rates in communities of the same character.

The municipal stations employed 2,467 wage-earners, who were paid wages amounting to $1,422,341, and 950 salaried officials and clerks, who were paid $457,381. Here, again, it should be understood that in many cases the same officials or the same workmen were charged with other duties, and when the amounts chargeable to electric lighting were not separately and specifically stated, they had to be determined by careful analysis.

The cost of construction and equipment of the municipal stations was only 4.4 per cent; their income from sale of current, 8.1 per cent; their expenses, 7.7 per cent; and the horsepower capacity of their power and generating plants, 8.7 and 9.4 per cent, respectively. The output of such stations was 7.8 per cent of the total kilowatt hours produced by all the stations, while their arc lamps were 13.2 per cent and their incandescent lamps, 8.7 per cent of all the lamps reported for the country.

In addition to controlling practically the entire industry, the average private station is much larger than the average municipal station. Considering the total of 2,805 private stations, it appears that the average total expense per year per station was $22,401, as compared with $6,437 for municipal stations. The private stations gave employment on the average to 7.4 wage-earners, while the municipal stations gave employment to 3. The average private stations reported 823,938 kilowatt hours per year, as compared with 240,373 for the municipal stations.

TABLE 2.—*Number of central electric stations beginning operations during each year.*

YEAR.	Total.	Private stations.	Municipal stations.
Total	3,620	2,805	815
1902 (January 1 to June 1)	146	106	40
1901	250	185	65
1900	213	152	61
1899	237	178	59
1898	277	195	82
1897	228	170	58
1896	193	129	64
1895	239	166	73
1894	191	144	47
1893	192	161	31
1892	247	190	57
1891	198	157	41
1890	227	198	29
1889	208	168	40
1888	160	142	18
1887	147	127	20
1886	100	86	14
1885	55	49	6
1884	47	43	4
1883	27	25	2
1882	30	27	3
1881	8	7	1

By means of Table 2 the beginnings of the industry are carried back to the first years of central station development on a commercial basis. The 3,620 stations comprised 2,805 that were private or corporate enterprises and 815 that were carried on by municipalities. The table does not include any stations that had gone out of existence prior to 1902, or those merged with other plants, and to that extent falls short of indicating the full number installed each year. Inquiry as to the exact number of those that had gone out of existence yielded very indefinite results, but it does not appear that the number is very large, much the greater number, as a matter of fact, having been merged in later enterprises.

It will be seen from the table that from 8 stations beginning operation in 1881 the number rose to 100 in 1886, to 208 in 1889, and to 247 in 1892—a year that will be remembered as marking the crest of a long period of prosperity. During the following years of depression the number fell again, but in 1895, which was a time of financial stringency and consequently of small desire to engage in new enterprises, the number again rose to the remarkable point of 239, while in 1898 it reached 277, or more than the number beginning operations during the whole period from 1881 to 1886, inclusive. The number for the year 1901 was 250, and for only five months of the year 1902 there were 146 new stations, from which fact it would appear that in all probability the rate of increase not only had been sustained, but also had reached a higher point than at any other time during the twenty-two years. Taking the period from 1881 to 1901, inclusive, it will be seen that an average of 165 private and municipal stations have begun operations each year.

The spread of the agitation for municipal ownership of public service enterprises is illustrated in a somewhat striking manner in Table 2. Of the 815 municipal stations enumerated, only 68 had been put in up to 1889. In that year 40 were introduced and in 1895 the number of new stations reached 73, increasing in 1898 to 82. The returns for 1902 indicate that the ratio was fully maintained in the census year.

The conditions during late years, moreover, are affected by the fact that the larger centers of population were furnished with central stations during the earlier years of the industry, and, consequently, the new plants are more likely to represent individual enterprises in smaller towns and cities that had not been previously supplied but had, in fact, just reached the stage at which it was profitable or desirable to create a private or municipal investment in them for electric lighting.

Ownership of stations.—In further consideration of the total number of stations, attention is called to the fact that 2,805, or 77.5 per cent, were operated under private or corporate ownership, while 815, or 22.5 per cent, were operated under municipal control. In 1902, 13 stations that had been installed under municipal con-

trol were being operated under private ownership. Of the 815 municipal stations, 77 began operations under private or partnership management and 93 under corporate management. Table 69 shows further division of the statistics for stations under private ownership and reveals the fact that 964 stations, or 34.4 per cent, were installed by individuals or firms and 1,828, or 65.2 per cent, by corporations. As might be expected, however, since from many points of view the nature of the business requires corporate management, the number of stations operated by individuals or private firms has shown a tendency to decline, and at the time of the enumeration in 1902 it had fallen to 756, or 27 per cent, while the number controlled by corporations had increased to 2,049, or 73 per cent.

Relation of leading items to geographic divisions.—In the following table the number of all stations and of private and municipal stations, respectively, together with various other items, are shown for the different geographic divisions:

TABLE 3.—RELATION OF LEADING ITEMS TO POPULATION—CENTRAL ELECTRIC LIGHT AND POWER STATIONS, BY GEOGRAPHIC DIVISIONS: 1902.

DIVISION.	Population.	NUMBER OF STATIONS.			COST OF CONSTRUCTION AND EQUIPMENT.		HORSEPOWER OF POWER PLANT.		HORSEPOWER OF GENERATING PLANT.		OUTPUT OF STATION IN KILOWATT HOURS.		ARC LAMPS.		INCANDESCENT LAMPS.	
		Total.	Private.	Municipal.	Amount.	Per capita.	Amount.	Per capita.	Amount.	Per capita.	Amount.	Per capita.	Number.	Per capita.	Number.	Per capita.
United States..	75,994,575	3,620	2,805	815	$504,740,352	$6.64	1,845,048	0.0243	1,624,980	0.0214	2,507,051,115	32.99	385,698	0.0051	18,194,044	0.2394
North Atlantic	21,046,695	913	810	103	266,548,738	12.66	814,728	0.0387	693,765	0.0330	1,269,331,001	60.31	169,554	0.0081	8,561,205	0.4068
South Atlantic	10,443,480	251	176	75	19,462,480	1.86	92,641	0.0089	83,515	0.0080	102,990,575	9.86	17,183	0.0016	611,001	0.0585
North Central	26,333,004	1,706	1,178	528	127,495,351	4.84	539,669	0.0205	503,368	0.0191	645,062,113	24.50	145,529	0.0055	6,176,919	0.2346
South Central	14,080,047	404	323	81	22,328,727	1.59	117,192	0.0083	110,266	0.0078	153,905,350	10.93	23,320	0.0017	1,022,298	0.0726
Western	4,091,349	346	318	28	68,905,056	16.84	280,818	0.0686	234,066	0.0572	335,762,076	82.07	30,112	0.0074	1,822,621	0.4455

The greatest number of central stations was found in the North Central states. According to Table 65 this division contained in 1890, 43.1 per cent of all the stations in the United States, a proportion which in 1902 had increased to 47.1 per cent. The greatest percentage of increase in the number of stations is found in the South Central states. Up to 1890 only 79 stations had been installed in that division. In 1902 this number had increased to 404, a gain of 411.4 per cent during the period. This remarkable gain is seen to be coincident with the greater industrial activity in the South.

While the number of stations in the North Central region is almost equal to the total for all the other sections of the country, it is only in this respect and in the number of inhabitants that this region preponderates to any extent in the comparison. In the North Atlantic states the 913 stations represented a cost of construction and equipment of $266,548,738, or slightly more than half of the total for the whole country, and they served more than one-quarter of the whole population. The output of these stations was almost exactly one-half of the total for the country, namely, 1,269,331,001 kilowatt hours out of a total of 2,507,051,115. While the average per capita consumption for the year was barely 33 kilowatt hours for the whole country, it was 60.3 kilowatt hours for the North Atlantic states. Of the total horsepower of the power plants, 814,728 horsepower, or 44.2 per cent, was located in the North Atlantic division. In this division the proportion of the dynamo generating power was almost the same, being 42.7 per cent, or 693,765 horsepower, out of 1,624,980 horsepower.

The two main items of central station work are arc lighting and incandescent lighting. Of the 385,698 arc lamps in the United States in 1902, 169,554 were to be found in the North Atlantic division, but the North Central division compared closely with this, having 145,529, so that these two divisions reported 315,083, or 81.7 per cent of the total. Moreover, these two divisions contained almost as high a percentage of incandescent lamps, for out of a total of 18,194,044 such lamps, 8,561,205 were reported in the North Atlantic division and 6,176,919 in the North Central division.

The South Atlantic division, although not the smallest as to population served, contained the smallest number of stations, namely, 251, with a cost of construction and equipment of $19,462,480, while the stations in the South Central division numbered 404 and cost $22,328,727. It will be noted that as compared with these, the Western division, with a population of only 4,091,349, had 346 stations with a cost of $68,905,056. These figures speak eloquently not only of the greater development of electric lighting in the Far West but also of the higher cost per plant and of the fuller service to the community. While in the South Atlantic and South Central divisions the per capita horsepower of power plants was only 0.0089 and 0.0083, respectively, it rose in the Western division to 0.0686, or nearly twice as much as the average of 0.0387 in the North Atlantic division. The consumption of current in the Western division was 82 kilowatt hours per capita, or about eight times as great as the consumption in either the South Atlantic or the South Central division, and more than three times as great as that in the North Central division. The explanation of the large consumption of current in the Western division is found in the figures of the arc and

incandescent lamps installed there. There were 17,183 arc lamps in the South Atlantic states, 23,320 in the South Central, and 30,112 in the Western. In like manner, while there were 611,001 incandescent lamps in the South Atlantic division, and 1,022,298 in the South Central, there were in the Western 1,822,621, or more than the total for the two southern divisions. While the per capita of the arc lamps in the Western division was slightly less than that of the North Atlantic states, namely, 0.0074, as compared with 0.0081, the conditions were reversed with regard to incandescent lamps, the per capita for the Western division being 0.4455, as compared with 0.4068 for the North Atlantic division. The per capita for incandescent lamps in the Western division was nearly twice as great as that for the North Central division, which showed 0.2346. With regard to the number of arc lamps, however, the difference between these two divisions was not so great, the per capita being 0.0055 for the North Central division, as compared with 0.0074 for the Western division.

It does not follow, however, that these figures are altogether an exhibition or reflection of the relative enterprise and development of the various sections. The presence of large industries or of large centers of population has its effect in various ways. Interesting light upon the attitude of the people in different sections toward electric applications is furnished by the earnings in the states and cities, reported and discussed elsewhere. Because of the newness of many of the communities in the Western division, the central station has often been the first public service plant of any kind installed, so that the public have had to depend upon it almost exclusively for lighting, and sometimes for power, while the management has not had to meet the competition of gas plants, which are naturally more numerous in the older settled portions of the country.

The average cost of construction and equipment for the 3,620 stations enumerated was $139,431, with which it is interesting to compare the average for the gas companies, namely, $646,523, although the latter is apparently rather on the basis of capitalization than investment. The average cost of construction and equipment for stations in the North Atlantic division was $291,948. Following this in magnitude came the western stations with $199,148, the South Atlantic with $77,540, the North Central with $74,733, and the South Central with $55,269.

When it is considered that many of the western plants are of the latest construction and would therefore have the benefit of all the economies introduced, the high ratio of cost of construction and equipment seems in need of explanation. One plausible reason for it is that a number of western plants included long distance transmission circuits, which would tend very much to increase the construction cost. Another is that many stations are remote from the mechanical centers at which the apparatus is produced, and the freight charges are therefore heavy. A third reason is probably to be found in the fact that while the plants of the older sections of the country are not equipped greatly in advance of the prospective growth, the western plants have been boldly equipped with an eye to the future and on a scale exemplifying the hopefulness of the investor with regard to the rapid development of that region. It might be urged, also, that the scale of prices for construction and equipment in the Far West is on the average higher than elsewhere in the country, but this argument might be equally true of many sections of the South. Although this statement does not apply to labor, it is a fact worthy of note that the work involved in the construction and equipment of a central station is of a high technical character wherever performed. A large expenditure, however, is justified by the liberal patronage bestowed on the western stations, the kilowatt hour consumption of current being, as already noted, much larger in that division than in any other section.

Distribution of stations, by states.—From Table 65 it will be seen that the largest number of stations was in Illinois, followed by Pennsylvania, New York, Ohio, Michigan, Indiana, Iowa, and Wisconsin in the order named. No other state reached the 150 mark. The New England states were well supplied with stations. Massachusetts reported the largest number; then came Maine, Vermont, New Hampshire, and Connecticut. Among the Southern states Texas led, with Kentucky, Tennessee, and Georgia following. Of the Western states, California reported the largest number of stations, Colorado, Washington, Oregon, and Montana being next in order.

Distribution of stations according to population of places in which located.—Of the 1,892 places reported at the Twelfth Census as having a population of 2,500 and over, 1,511 had one or more central electric lighting stations that were operated either as independent enterprises or in connection with electric railways. Of the places with a smaller population, 1,960 had similar stations. As elsewhere noted, a number of large central electric light or power stations furnished current to surrounding cities, towns, and villages, either directly or through the intermediary of substations, and it would be very difficult to include all the population of the country to which central station current was available, a mere enumeration of the places where the stations are installed by no means indicating alike the topographic location of the plants and the territorial distribution of the current. There are, in fact, a number of companies supplying areas of many square miles in which are located scores of cities, towns, incorporated villages, and mere hamlets, all enjoying the benefits of electricity and constituting a source of income for the enterprise. The extreme limit of such work at the time of this report was marked by the long distance power transmission on the Pacific coast, where current from the Sierras was actually delivered for general consumption in San Francisco and Sausalito, and was also distributed from the

same plants over lines which ramify into half the counties of the state of California.

The whole aspect of central station current supply in its relation to population has in reality been utterly changed by the development of polyphase power transmission, which will be treated more fully in a later chapter of this report. Utilizing chiefly remote waterpowers, but depending in many cases upon coal, hundreds of power transmission plants have been put in with the sole object of furnishing current for both light and power over large areas. Thus, in numerous instances, the production of current has been minimized in the city of consumption itself, the supply coming from points scores of miles away and being available, therefore, not only in the heart of the business community it is primarily intended to serve, but also in numerous little communities intermediate, which but for this technical advance would have remained without the convenience of electricity, or without it, might not have existed. There are at least a thousand such transmission plants, and a cursory examination of the statistics shows that the transmission lines were frequently 15 or 20 miles long, in many cases 40 or 50 miles, not seldom 60 or 90 miles, and sometimes even 150 or 200 miles.

These transmission enterprises are peculiarly typical of the far Western states, but are by no means concentrated there, being scattered all over the Union, particularly in mountainous regions where water supply, even if not abundant, can be secured with a good head, the height of the fall thus compensating for the smallness of volume.

The classification of central stations in groups of cities of different population brings out a number of interesting facts as to the degree of dependency of the public upon private enterprise and upon municipal control in this field of industrial endeavor. In Table 4 the number and percentages of private and municipal stations, respectively, are shown for cities grouped according to population.

TABLE 4.—*Number of private and municipal stations, grouped in places classified by size, and percentage each group is of total: 1902.*

POPULATION OF PLACES IN WHICH LOCATED.	TOTAL.		PRIVATE STATIONS.		MUNICIPAL STATIONS.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Total	3,620	100.0	2,805	100.0	815	100.0
Under 5,000	2,714	75.0	2,043	72.8	671	82.3
5,000 but under 25,000	675	18.7	554	19.8	121	14.9
25,000 but under 100,000	128	3.5	115	4.1	13	1.6
100,000 but under 500,000	73	2.0	67	2.4	6	0.7
500,000 and over	30	0.8	26	0.9	4	0.5

It will be seen that 2,714, or three-fourths of all the central stations reporting in 1902, were located in places of less than 5,000 inhabitants; of the private stations 72.8 per cent were in this group, while not less than 82.3 per cent of the municipal plants were to be found in it. In both cases the percentage is high and exemplifies the wide diffusion and enjoyment of the facilities afforded by such services. In this respect the small towns of the North Central states appear to have had exceptional advantages, as of the stations in Illinois and Iowa 428, or 83.1 per cent, were in the small towns, while in Ohio and Indiana 284, or 68.8 per cent, were so located.

Distribution of stations according to dynamo capacity.—Table 5 segregates the central electric stations according to the horsepower capacity of the dynamos and assists in determining the relative size of the municipal and private stations.

TABLE 5.—*Number of private and municipal stations, grouped according to dynamo capacity, and percentage each group is of total: 1902.*

HORSEPOWER CAPACITY OF DYNAMOS.	TOTAL.		PRIVATE STATIONS.		MUNICIPAL STATIONS.	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
Total	3,620	100.0	2,805	100.0	815	100.0
Under 200	2,262	62.5	1,650	58.8	612	75.1
200 but under 500	864	23.9	700	24.9	164	20.1
500 but under 1,000	226	6.2	201	7.2	25	3.1
1,000 but under 2,000	137	3.8	126	4.5	11	1.4
2,000 but under 5,000	83	2.3	81	2.9	2	0.2
5,000 and over	48	1.3	47	1.7	1	0.1

More than one-half of the private stations and three-fourths of those operated under municipal control had a dynamo capacity of less than 200 horsepower. A dynamo capacity of less than 500 horsepower was reported for 86.4 per cent of all central electric stations, 83.8 per cent of the stations operated under private ownership, and 95.2 per cent of the stations operated under municipal control. Of the total number of private stations 7.2 per cent had a dynamo capacity of between 500 and 1,000 horsepower, while 3.1 per cent of the municipal stations were included in this group. The dynamos of only 1.7 per cent of the municipal stations and 9.1 per cent of the private stations had a horsepower capacity exceeding 1,000.

In 3,308 stations the dynamos were operated by the use of steam or steam and water power. In a number of cases the steampower was merely auxiliary to the waterpower, being used only when the waterpower was not available. There were 312 stations in which the machines were operated by the use of waterpower exclusively. These stations had 612 water wheels with a stated capacity of 217,261 horsepower and a dynamo capacity of 171,988 horsepower, the kilowatt hour output of current for the year being 258,698,131.

Concentration in large cities.—For each group of cities with a population of more than 5,000 the percentage of private plants is greater than that for municipal stations. The importance of the industry in cities having a population of 500,000 and over is brought out quite forcibly by the following table, which shows the leading items by cities:

TABLE 6.—CENTRAL ELECTRIC STATIONS IN CITIES HAVING A POPULATION OF 500,000 OR OVER: 1902.

	Total.	New York.	Chicago.	St. Louis.	Boston, Philadelphia, and Baltimore.
Number of stations	30	7	9	5	9
Stock issued	$116,001,550	$61,744,600	$11,954,300	$6,400,000	$35,902,650
Dividends	$1,909,629	$150,000	$515,982	$30,000	$1,213,647
Bonds outstanding	$97,959,002	$50,246,000	$9,508,000	$5,000,000	$33,205,002
Cost of construction and equipment	$111,004,658	$41,667,897	$24,399,685	$12,050,313	$32,886,763
Gross income	$20,956,944	$9,847,215	$3,543,737	$1,270,573	$6,295,419
Income from sale of current	$20,909,520	$9,836,266	$3,543,737	$1,267,819	$6,261,698
Arc lighting	$6,428,993	$2,811,723	$1,147,699	$330,369	$2,139,202
Incandescent lighting	$10,988,025	$5,231,102	$1,859,148	$592,150	$3,305,625
All other electric service	$3,492,502	$1,793,441	$536,890	$345,300	$816,871
Income from all other sources	$47,424	$10,949	.....	$2,754	$33,721
Total expenses	$17,376,301	$8,628,894	$2,466,628	$1,153,383	$5,127,396
Salaries and wages	$4,749,167	$2,184,629	$745,401	$389,669	$1,429,468
Cost of supplies, materials, and fuel	$4,369,550	$2,252,614	$741,447	$366,721	$1,008,768
Rents and miscellaneous expenses	$3,547,438	$1,718,351	$511,536	$140,993	$1,176,558
Interest on bonds	$4,710,146	$2,473,300	$468,244	$256,000	$1,512,602
Salaried officials and clerks:					
Number	1,022	348	267	80	327
Salaries	$1,154,882	$368,868	$278,873	$101,584	$405,557
Wage-earners:					
Average number	4,799	2,358	624	390	1,427
Wages	$3,594,285	$1,815,761	$466,528	$288,085	$1,023,911
Horsepower of power plants	261,640	111,880	46,885	21,052	81,823
Horsepower of generating plants	224,054	76,579	48,623	21,383	77,469
Output of stations in kilowatt hours, total for year	368,632,306	153,288,077	67,479,260	28,578,460	119,286,509
Miles of mains and feeders	17,599.95	4,193.19	1,606.72	812.67	10,987.37

The 30 stations reported from these 6 cities had a notably large proportion of the investment and equipment of the industry as a whole. Out of a total of $504,740,352, given as the cost of construction and equipment for all the central stations of the country to date, $111,004,658, or over 20 per cent, was returned for these cities, while of the gross income of $85,700,605, $20,956,944, or very nearly 25 per cent, was returned for them.

The same concentration of investment relative to population is shown by a study of Table 66. Thus New York state, with only 256 stations, but with a population in 1900 of over seven millions, reported a cost for construction and equipment of $112,998,778. Pennsylvania, with a population of 6,302,115, had only 279 stations, but reported a cost for construction and equipment of $41,579,338. It will be seen that the status of the industry as to amount of investment bore a closer relationship to density of population than to the mere number of stations, since Illinois, which led in number with 346 stations and had 4,821,550 inhabitants, reported but $38,329,275 as the cost of construction and equipment. Michigan, with 201 stations, reported $11,559,169, and Indiana, with 180, reported $6,706,510. In the last two states, however, there was a liberal sprinkling of municipal plants, Michigan having 81 and Indiana 62, which would swell the gross totals.

Character of service.—The different purposes for which private and municipal stations supply current are shown in Tables 69 and 79 by the number of stations in the states and territories. The totals for the United States are summarized in the following table:

TABLE 7.—*Number of private and municipal stations, classified according to character of service: 1902.*

CHARACTER OF SERVICE.	Total.	Private stations.	Municipal stations.
Arc lighting:			
Commercial or other private	2,020	1,667	353
Public	2,522	1,810	712
Incandescent lighting:			
Commercial or other private	3,484	2,752	732
Public	2,491	1,889	602
Motor power:			
Stationary	1,093	975	118
Electric railway	159	157	2
All other service	161	152	9

It is evident from Table 7 that the principal business of central electric stations is to supply current for illumination. Eleven of the stations under private ownership furnished current for public lighting exclusively, and all under municipal control supplied current for that purpose. In the earlier days of the industry nearly all the stations were installed for the purpose of furnishing arc lighting, but the change that has come over the industry is indicated by the table, which shows that, of the 3,620 stations, 3,484 were engaged in commercial or other private incandescent lighting. As to arc lighting, 2,522 stations supplied public or street circuits, while 2,020 furnished current for commercial or other private arc service.

Of the private stations, 21 reported the sale of current for arc lighting exclusively, 526 for incandescent lighting exclusively, and 18 for power purposes exclusively. Of the municipal stations, 61 reported current for arc lighting only and 80 for incandescent lighting only.

While municipal stations were in most cases established primarily to supply street lights where none existed before, or to replace service for which private stations were believed to be charging too high rates, such plants now engage in a general illuminating business, also, and in 1902, all but 77 of them sold current to private consumers. With regard to the stations reporting current for power purposes only, it is to be borne in mind that in connection with power transmission work a separate class of stations is springing up, generating current for customers at remote points, without any regard to the use that is to be made of it, and without coming in direct relationship with the individual consumers. Their function as electric light plants has become merged in a much wider one. These stations may be compared to wholesale producers, while the companies or substations receiving the current in bulk and subdividing it may be compared to jobbers and retailers. One of the results of this tendency is that power transmission schemes have been made the means of unifying and bringing together under one management a number of public service electric enterprises, some of which would have been menaced by the new competition and by current generated more cheaply than the older conditions permitted. In this work we have again an industrial parallel with large manufacturers who operate their own factories, establish or buy up stores in the leading cities, and dispose of their goods directly to the public.

Municipal stations are engaged in both kinds of lighting, but the proportion engaged in public arc lighting is very much larger for them than for private stations. In other words, while 1,810, or 64.5 per cent, of the private stations supplied public arc lights, 712, or 87.4 per cent, of the municipal plants did this class of work. The tables are decidedly turned, however, when attention is directed to the statistics as to the supply of motor power. Of the stations, 1,093 supplied current for stationary motors, and 159 furnished current for electric railways. From an inspection of the table it is seen that nine-tenths of the stations furnishing this service were private, which is a striking evidence of the fact that as a rule municipal stations are restricted to illumination and do not operate their plants in the daytime. Only 118 municipal plants supplied current to stationary motors, and only 2—1 at Riverside, Cal., and 1 at Hannibal, Mo.—furnished electric railways with power. It may be questioned whether there were any cases in which current for motors was required from the municipal plants after daylight hours, and the obvious inference is that where no current was furnished for power purposes the plants did not operate what are known as "day circuits." This simple fact is in itself a sign of the conditions under which municipal plants operate, showing that the great majority of them are not only small, but are in communities where the demand for current for power purposes in the daytime is so insignificant as not to make it worth while for the plant to run from sunrise to sunset.

The "all other service," referred to in Table 7, relates to service supplied for the miscellaneous purposes indicated in the following statement:

Miscellaneous service.

CHARACTER OF SERVICE.	Total.	Private stations.	Municipal stations.
Charging telephone exchanges	4	3	1
Charging batteries for boats	3	2	1
Charging other batteries	6	5	1
Charging automobiles	26	23	3
Pumping	58	53	5
Hot water heating	6	6	.....
Steam heating	45	42	3
Electric heating	31	29	2
Hot water	2	2	.....
Steam	26	23	3
Electric current	64	60	4
Nickel plating and electroplating	3	3	.....

In addition to the revenue obtained from supplying electric current or service for the purposes indicated in the above statement, a number of the central stations derived revenue from miscellaneous sources, such as the rent of lamps, poles, wires, meters, motors, and conduits; also from furnishing current for medical and dental purposes, welding of carriage tires, etc. A number of stations furnished current on the meter basis entirely, and no record was made of the purposes for which it was used; therefore the foregoing can not be considered a complete list of the uses to which current was applied during the year.

Work of pioneer stations.—The pioneer arc lighting stations were almost wholly restricted to operation after dark. Although for several years attempts were made to introduce motors on their circuits, all of the conditions were distinctly unfavorable. While it was possible to operate lamps out of arm's reach on tall poles with currents of pressure highly dangerous to life, it was found impossible to surround motors using current of the same tension with sufficient safeguards, and, moreover, the motors were liable to frequent interruption for technical reasons which need not be discussed here. With the introduction of incandescent lighting, however, for which the circuits are operated in parallel rather than in series and depend not upon high tension current but upon current of such low pressure that it can be safely introduced anywhere, the motor industry as associated with central stations took a tremendous leap forward, so that in the year under report the supply of power current constituted a vital portion of the central station business in any community, even one of ordinary size. Electric motor service, whether for factories or for electric railways, is required from early daylight until dusk and often through the night hours, whereas lighting, except in the case of street arc light circuits furnished all night, is normally restricted to a few hours in the evening, and possibly one or two hours in the morning during the winter. Many critics and authorities are of the opinion that successful as the

electric lighting industry has proven to be, it could hardly have survived, and certainly could not have attained its present proportions in so short a space of time, if the electric motor had not come to the support of the electric lamp.

Places served exclusively by municipal stations.—The real value of municipal plants in small communities is best brought out by the following table, which presents the leading items, by states, for stations in places served exclusively by municipal stations:

TABLE 8.—STATISTICS OF STATIONS IN CITIES AND TOWNS SERVED EXCLUSIVELY BY MUNICIPAL STATIONS, BY STATES: 1902.

STATE OR TERRITORY.	Number of stations.	Population.	Cost of construction and equipment.	INCOME FROM SALE OF CURRENT FOR—				Salaries and wages.	Cost of supplies and materials, not including fuel.	Cost of fuel.	Miscellaneous expenses.	HORSEPOWER CAPACITY OF—		Output of stations, kilowatt hours, total for year.	NUMBER OF LAMPS.	
				All electric service.	Arc lighting.	Incandescent lighting.	All other electric service.					Steam engines and water wheels.	Dynamos.		Arc.	Incandescent.
United States.	732	2,052,485	$15,369,382	$4,814,568	$1,691,920	$3,049,815	$72,833	$1,354,833	$760,136	$1,124,403	$327,980	122,880	114,105	148,913,431	28,631	1,465,582
Alabama	9	14,664	110,290	44,974	13,528	31,266	180	9,960	5,161	11,861	2,000	935	873	1,053,002	254	8,385
Arkansas	7	12,935	75,120	31,031	8,077	22,654	300	8,915	4,512	10,610	2,330	840	662	838,965	115	7,043
California	8	36,571	391,081	113,171	25,103	74,856	13,212	30,454	23,929	17,817	7,338	2,035	1,928	2,329,145	323	29,491
Colorado	2	1,402	14,940	5,526	720	4,806	.....	1,620	264	1,980	644	120	94	86,230	12	955
Connecticut	3	15,552	135,332	45,936	15,911	27,481	2,544	10,705	5,537	11,448	2,383	900	520	843,844	249	11,369
Delaware	6	13,036	83,562	26,599	3,341	23,258	.....	8,019	5,730	5,650	1,948	812	700	1,238,525	100	7,445
Florida	4	10,112	48,698	23,752	7,157	16,595	.....	6,697	1,944	10,627	858	435	360	420,433	104	4,080
Georgia	17	47,587	330,962	118,460	44,344	74,116	.....	30,175	23,023	23,653	3,671	2,638	1,961	3,299,946	632	25,475
Idaho	1	1,262	6,930	5,652	840	4,812	.....	2,970	1,060	.....	.....	.....	90	235,790	14	1,033
Illinois	67	135,070	1,151,375	352,427	111,473	240,686	268	105,936	33,120	103,698	24,809	9,240	8,356	9,648,317	1,809	116,226
Indiana	52	163,618	1,188,140	404,991	182,073	220,056	2,862	106,458	69,258	86,071	24,973	10,279	10,388	16,674,275	2,968	123,124
Iowa	36	80,374	669,108	224,361	37,992	184,383	1,986	60,033	28,062	64,970	16,300	5,751	5,067	6,093,089	703	77,501
Kansas	9	32,559	134,213	38,461	21,906	15,666	889	11,365	8,324	5,516	2,838	1,200	1,002	1,323,356	410	8,713
Kentucky	6	31,557	186,186	49,731	27,556	20,675	1,500	15,459	6,950	9,523	2,954	1,640	1,428	2,894,800	493	11,385
Louisiana	10	30,676	207,600	75,516	18,942	54,561	2,013	24,906	14,348	15,641	4,545	1,380	1,354	2,594,410	223	15,692
Maine	1	23,761	23,000	9,600	9,600	.....	.....	4,264	1,122	.....	200	250	160	522,680	192	.....
Maryland	2	3,551	16,050	5,062	612	4,450	.....	1,818	609	1,620	32	135	113	148,920	17	1,510
Massachusetts	17	151,407	1,227,261	264,922	96,486	164,660	3,776	87,271	49,160	56,521	37,296	6,255	6,551	4,195,074	1,731	94,439
Michigan	74	209,022	1,649,429	453,906	170,769	275,613	7,524	133,570	66,170	101,711	31,918	14,321	12,055	16,516,530	3,412	175,561
Minnesota	69	133,612	1,114,440	407,557	104,302	300,585	2,670	106,605	62,854	112,137	22,251	9,363	7,972	11,081,790	1,687	136,590
Mississippi	18	40,406	303,959	115,319	32,436	81,224	1,659	29,427	21,286	27,739	4,152	2,885	2,479	3,312,403	450	27,205
Missouri	39	94,593	642,353	194,573	62,279	128,816	3,478	49,685	21,888	58,494	11,268	5,573	4,850	5,771,412	998	51,886
Montana	1	1,938	32,000	16,208	4,000	12,148	60	3,204	2,910	3,264	1,390	250	1,450	718,320	43	2,825
Nebraska	10	24,535	119,834	45,082	11,596	33,045	441	12,152	7,053	11,341	1,791	1,206	1,159	1,363,275	275	18,626
New Hampshire	1	2,390	9,800	3,250	.....	3,250	.....	600	2,213	.....	.....	150	100	324,120	.....	1,664
New Jersey	4	10,868	193,465	42,653	11,200	31,368	85	9,221	2,631	7,972	2,208	1,085	1,463	877,096	170	16,160
New York	25	81,929	577,820	166,416	85,589	79,496	1,331	49,467	23,899	45,316	13,951	5,119	4,343	5,182,605	1,299	55,815
North Carolina	15	41,183	211,432	87,386	40,456	46,750	180	21,164	13,639	20,792	3,115	2,030	1,929	2,528,080	609	19,981
North Dakota	7	10,632	83,965	47,444	10,185	37,259	.....	12,570	3,018	17,473	1,895	820	511	1,107,045	108	9,960
Ohio	82	211,651	1,723,072	610,395	271,145	331,724	7,526	169,327	91,283	135,211	30,770	15,601	15,261	23,419,569	4,479	163,587
Oklahoma	2	4,732	30,338	13,761	3,408	10,353	.....	4,320	1,224	3,207	1,122	362	220	216,080	40	3,500
Oregon	6	6,102	49,038	21,320	3,776	17,544	.....	5,640	1,447	6,717	1,449	318	358	550,930	40	3,411
Pennsylvania	30	94,898	579,937	168,559	78,914	87,548	2,097	56,690	29,472	38,417	15,114	4,785	4,633	5,991,988	1,345	45,305
Rhode Island	1	(1)	22,919	8,769	5,134	3,635	.....	2,330	1,808	1,538	1,459	100	125	114,975	56	1,500
South Carolina	8	32,342	130,153	47,007	22,763	24,244	.....	14,557	8,817	14,474	2,595	1,260	1,130	1,853,213	380	10,520
South Dakota	5	9,723	73,057	21,429	4,632	16,797	.....	5,738	5,574	4,617	606	520	628	352,639	66	13,228
Tennessee	16	34,357	182,962	60,967	18,760	41,807	400	16,859	7,368	18,045	1,895	1,936	1,790	2,245,995	390	14,564
Texas	4	31,937	106,938	70,360	14,045	50,885	5,430	21,055	17,198	11,648	6,055	1,675	2,275	1,456,120	236	16,672
Utah	1	2,686	9,499	2,870	20	2,850	.....	1,560	158	.....	184	125	47	92,746	1	1,035
Vermont	11	11,578	352,449	46,550	2,825	38,405	5,320	14,520	2,977	1,152	6,729	3,461	2,420	3,768,260	85	33,325
Virginia	9	44,967	193,649	49,435	29,396	19,558	481	14,235	6,766	8,659	3,814	1,080	1,262	1,901,097	431	7,212
Washington	7	50,003	583,880	147,380	43,609	99,150	4,621	39,987	62,923	7,410	16,098	590	632	938,415	967	36,084
West Virginia	4	3,623	28,466	9,599	4,130	5,469	.....	3,680	964	3,220	526	351	250	331,893	81	2,556
Wisconsin	26	57,134	414,650	116,201	30,890	85,311	.....	29,745	12,498	26,643	10,506	3,124	3,161	2,461,045	656	52,949

[1] Population not reported separately.

This table shows the statistics for 732 stations operated in that number of communities, in which there was no competitive private service. It would appear that in all probability a great many if not all of these places would have gone without electric lighting had the supply been left to private enterprise seeking a return upon its investment. These 732 plants constituted 89.8 per cent of all the municipal plants in the country, and their totals formed about 70 per cent of the grand totals under most heads of the various items of equipment, income, expense, and output.

The population served by these stations was 2,052,485, an average of a little over 2,800 per station, and towns of this size rarely offer inducements to private capital, regarded from the per capita basis of consumption of current. These stations also represent a total cost of construction and equipment of $15,369,382, or about $21,000 per station, whereas the average cost of construction and equipment for the 3,620 central stations of all classes was slightly short of $140,000.

The details of the table bring out even more strikingly than the gross figures the smallness of the com-

munities served exclusively by municipal plants. The largest average population per community is shown for Massachusetts, having 17 stations, with an aggregate population of 151,407, or an average of 8,906. The smallest population per community is shown for Colorado, with two municipal stations supplying 1,402 people, or an average of 701 for each station. An average of 5 persons to a family or house would give barely 140 houses. In some of these communities the small number indicates the uninviting prospect for private capital, but discloses at the same time a large amount of public spirit and a determination everywhere to enjoy the latest facilities of modern civilization.

The consolidation of lighting stations and other enterprises.—Reference has been made to the tendency to operate electric light plants in connection with other enterprises. From the reports it appears that at the time of this census 1,465 stations, or about 40 per cent of the total number, were carried on in conjunction with the making of gas, the operation of waterworks, the production of ice, and similar industries. The tendency is toward the massing together of such enterprises, the reason being the greater economy and efficiency resulting from placing a number of small establishments under one competent and well-paid administration. It should again be emphasized that the statistics of such stations relate exclusively to the generation of electric current.

Comparison of gas and electric lighting.—Because of its rapid development, electric lighting has already been placed in sharp competition with other means of artificial illumination, and with one of these, namely, that depending upon the manufacture of gas, it can be compared. The gas industry in the United States is nearly a century old, dating from 1806,[1] whereas central electric stations have been in existence only about twenty-five years, or since 1879, when two or three were to be found in limited operation. The latest available comparative census statistics for the two industries are shown in the following statement:

Comparative summary of central electric stations and gas plants.

	Central electric stations, 1902.	Gas plants, 1900.
Number of establishments	3,620	877
Cost of construction and equipment	$504,740,352	[1] $567,000,506
Cost of supplies, materials, and fuel	$22,915,982	$20,605,356
Salaried officials and clerks:		
Number	6,996	5,904
Salaries	$5,663,580	$5,273,500
Wage-earners:		
Average number	23,330	22,459
Wages	$14,983,112	$12,436,296
Income	$85,700,605	[2] $75,716,693

[1] Capital. [2] Value of products.

While these statistics for the two industries do not cover the same year, the periods reported correspond sufficiently for a general comparison. The totals shown for central electric stations exceed those for the manufacture of gas in all the items except the "cost of construction and equipment," which is compared with the capital reported for the gas companies. The capital stock and funded debt reported for the 2,049 central stations owned by corporations amounted to $627,515,875, and would possibly be the better total to compare with the capital reported for gas companies, namely, $567,000,506. The income for the central electric stations was $85,700,605, while the value of the gas products was $75,716,693.

It is true that in order to give full credit to the electric lighting industry it would be necessary to include the figures for isolated plants, which are usually assumed to be about equal to the central stations as regards extensiveness of equipment. These stations, however, would be offset by a large and unknown number of isolated gas plants. It is contended by authorities in the gas lighting field that these statistics as shown are not so complete a demonstration of commercial parallelism between the two industries as they are assumed to be. According to Brown's Directory of American Gas Companies, there were in the United States in 1903 about 950 gas companies making coal gas and water gas; over 400 natural gas plants supplying towns; and about 150 plants lighting towns by means of acetylene gas or gasoline. Therefore, for 1903–4 there would be about 1,500 gas lighting plants for towns, in this country, although all of them could not be designated as producers of manufactured gas. The natural gas companies, moreover, are highly capitalized, the Philadelphia Company of Pittsburg, for example, having a capital of over $45,000,000. In connection with the investments it may also be pointed out that the dividends paid by central stations averaged 1.7 per cent, and the interest on bonds, 4.7 per cent, while for the gas companies the rates were 4.2 per cent on stocks and 4.9 per cent on bonds.

The following table gives the relative distribution of the central electric stations and gas plants in cities of different population, and is very interesting in its revelation of the wider spread of electric stations:

TABLE 9.—*Number of central electric stations and gas plants in places classified by size.*

POPULATION OF PLACES IN WHICH LOCATED.	Central electric stations, 1902.	Gas plants, 1900.
Total	3,620	877
Under 5,000	2,714	200
5,000 but under 25,000	675	484
25,000 but under 100,000	128	124
100,000 but under 500,000	73	39
500,000 and over	30	30

In connection with this table it may be stated that in the United States in 1900 there were 827 cities and towns in which one or more gas plants were in opera-

[1] Twelfth Census, Vol. X, page 713.

tion, while in 1902 there were central electric stations in operation in all but 153 of these places. It will be observed from the table that 75 per cent of the central electric stations and 22.8 per cent of the gas plants were in places of less than 5,000 inhabitants. This, however, does not reveal the full extent of the benefit conferred by electric methods, the area of distribution from gas works being necessarily limited by physical and economic considerations, so that one gas plant can not supply more than three or four communities, while the electric lighting station can and often does supply light, heat, and power to many towns and villages scattered over many square miles of territory.

Combination of gas and electrical interests.—In many cities the competition of the gas and electric industries is undoubtedly as keen now as it was at any time during the last twenty-five years. On the other hand, in several hundred towns and cities the gas and electric lighting interests have been brought together and consolidated, very often on the initiative of the older gas interests, which have thus remained in control of the entire private lighting from a central source. There is a decided tendency toward this form of consolidation. In some places it already embraces also the street railways and the water supply service, while one or two instances could be quoted where the telephone systems have also been taken into the combination. The most conspicuous instance of united ownership of gas plants and central stations is to be found in New York city, where the entire system of electric lighting is under the absolute control of the Consolidated Gas Company of New York.

This tendency toward combination has been stimulated frequently by the insensate competition between the managements of the two methods of illumination, but is also due in large measure to the recognition of the fact that electricity, as it emerged from the earlier stages of experimentation, gave every promise of becoming a stable and lucrative industry which could be operated quite advantageously along the lines already proved best in the development of gas lighting.

Comparison with census of 1890.—It is perhaps unfortunate that the figures for central electric stations are not as a whole subject to any comparison with those of any previous census period. The only figures for the previous decade that are available for comparison apply to the state of New York, for which a partial canvass was made in the census year 1890. As a matter of fact, the industry had not developed sufficiently in 1880 to be included as a whole in the census report for that year. The statistics reported at the censuses of 1890 and 1902 for this industry in the state of New York are summarized in Table 10, and are a further indication of the rate of increase maintained by the industry during the past twelve years.

TABLE 10.—*Comparative summary—central electric stations in New York state: 1902 and 1890.*

	1902	1890	INCREASE.	
			Amount.	Per cent.
Number of stations	256	139	117	84
Cost of construction and equipment	$112,998,778	$31,183,618	$81,815,160	262
Total income	$16,854,839	$4,174,534	$12,680,305	304
From arc lighting	$4,944,575	$2,272,374	$2,672,201	118
Private	$1,818,499	$951,810	$866,689	91
Public	$3,126,076	$1,320,564	$1,805,512	137
From incandescent lighting	$7,976,232	$1,585,834	$6,390,398	403
Private	$7,540,994	$1,522,316	$6,018,678	395
Public	$435,238	$63,518	$371,720	585
From motor service	$2,396,046	$192,754	$2,203,292	1,143
From miscellaneous service	$1,537,986	$123,572	$1,414,414	1,145
Salaries and wages	$3,904,706	$1,375,861	$2,528,845	184
Supplies and materials	$2,433,526	$467,842	$1,965,684	420
Fuel	$1,494,043	$513,794	$980,249	191
Miscellaneous expenses	$2,662,001	$720,128	$1,941,873	270
Total horsepower of power plants	323,413	59,512	263,901	443
Total horsepower of dynamos	251,007	41,844	209,163	500
Lighting service:				
Total number of arc lamps	59,130	19,834	39,296	198
Private	26,806	8,885	17,921	202
Public	32,324	10,949	21,375	195
Total number of incandescent lamps	3,705,525	286,935	3,418,590	1,191
Private	3,561,934	280,989	3,280,945	1,168
Public	143,591	5,946	137,645	2,315

The totals for 1890 do not include the report for a central station operated by the municipality of Dunkirk. The totals for 1902 include the returns for 28 stations operated by municipalities. Of these, 3 were installed under private ownership and were so reported at the census of 1890, but subsequently came under municipal control. The rate of increase for the number of stations was 84 per cent, but the rates for cost of construction and equipment, income, expenses, horsepower capacity, and services were much greater, since the totals for each of these items had more than doubled during the twelve years. The average horsepower capacity of the 139 stations reported in 1890 was only 428 for the power plant and 301 for the generating plant, as compared with 1,263 and 980, respectively, for the 256 stations reported in 1902. In 1890 the average number of arc lamps per station was 143 and of incandescent lamps 2,064, while in 1902 these averages had increased to 231 and 14,475, respectively. Since the density of population is the principal inducement to the establishment of central electric stations, it is probable that the increase in New York is larger than that in other states, and therefore should not be accepted as a true indication of the rate of increase for the entire country.

CHAPTER III.

FINANCIAL OPERATIONS.

I.

CAPITAL STOCK AND FUNDED DEBT.

Private stations.—The number of central electric stations owned and operated by corporations, the amounts of their common and preferred stock authorized and issued, the amount of their outstanding bonds, the amount of interest paid on bonds during the year, the amount of dividends on both classes of stock and the total capital stock and funded debt are shown by states and territories in Table 69. For more convenient reference, the totals for the United States are given in the following table:

TABLE 11.—*Capital stock and funded debt—incorporated companies: 1902.*

Total capital stock and funded debt authorized	$743,296,266
Total capital stock and funded debt issued	627,515,875
Capital stock:	
Authorized	435,178,372
Issued	372,951,952
Dividends	6,189,837
Funded debt:	
Authorized	308,117,894
Outstanding	254,563,923
Interest	12,118,740

The total capital stock and funded debt authorized amounted to $743,296,266, but the amount issued was considerably less, being $627,515,875. Of the total amount authorized, $435,178,372, or 58.5 per cent, was capital stock, and $308,117,894, or 41.5 per cent, was funded debt. Of the total authorized capital stock, $372,951,952, or 85.7 per cent, had been issued at the end of the year covered by the report. Of the capital stock issued, $23,871,671, or 6.4 per cent, was preferred stock and $349,080,281, or 93.6 per cent, was common stock.

The common stock on which dividends were paid during the year amounted to $126,284,352, or only 36.2 per cent of the total issue, the dividends paid amounted to $5,560,341, or an average rate of 4.4 per cent on all the stock of that class paying dividends. The proportion of preferred stock paying dividends was somewhat higher, the value of the stock being $12,197,463, or 51.1 per cent of the amount issued; the dividends amounted to $629,496 and were at a rate of 5.2 per cent. Thus common stock to the value of $222,795,929 and preferred stock to the value of $11,674,208 paid no dividends. Only 589 companies reported that dividends were paid on either common or preferred stock; 561 paid dividends on common stock; 71 reported an issue of preferred stock, and 41 the payment of dividends on such stock; while but 13 paid dividends on both their common and their preferred stock. Of the funded debt authorized, $254,563,923, or 82.6 per cent, was outstanding at the end of the year. With regard to bonded indebtedness, 795 companies reported interest on $250,535,749, the rate averaging 4.8 per cent. It will be seen that whatever was the fate of a large proportion of the common and preferred stock, practically the whole of the fixed charges obligations were met, as there was indicated a default upon only $4,028,174 out of a total of $254,563,923 outstanding.

The total cost of construction and equipment of the 2,049 companies included in these totals amounted to $473,048,734, and was 75.4 per cent of the par value of the capital stock and funded debt of these companies.

Overcapitalization.—An inference fairly derivable from a study of these figures is that the electric light industry has, like some others, suffered from overcapitalization (this term being used in its broadest and most comprehensive sense), and this inference would appear to be justified by further figures resulting from the inquiry.

In such a new industry as that of electric light and power, and especially since the industry is complicated by being carried on frequently under the same roof or the same management with other enterprises, it is naturally very difficult to determine the exact nature of the overcapitalization or even, in fact, that overcapitalization exists to any serious extent. Of the 2,049 central stations operated under private ownership and controlled by corporations, 747 were carried on in connection with gas plants, waterworks, ice plants, sawmills, and other industries. Just as, in such cases, a great deal of the plant is operated and used indifferently for all the systems, as, for example, the same boilers and steam engines or the same water wheels, so also it is quite a common thing for the capital stock and bonds to cover the entire interests of a corporation, there being no separate issue for the electric part of the composite enterprise. This is particularly true of corporations that were originally chartered for the manufacture of gas or the operation of waterworks and later furnished themselves with an electric equipment, although in many instances an issue of bonds has been made in taking over an electric light plant already established—these bonds either serving to raise the money required for the transfer or being given in exchange for some or all of the stock of the electric light shareholders. Under these conditions it is obvi-

ously impossible to obtain an accurate enumeration of the capital stock or funded debt of electric light stations exclusively, and the amounts charged to stations subject to these conditions were therefore estimated. The capital stock and bonds reported in Table 69 may, however, be accepted as representing, with fair and close approximation, the capitalization of the corporations engaged in central station business in the United States.

Return on investment.—The rate of return on the capital stock and investment of some of the oldest central station companies was and has remained far larger than is indicated by the average figures which have been cited above, figures which, if accepted as the only criterion, might well act as a deterrent against venturing into an industry generally so unremunerative. It must be remembered, however, that in some cases qualifications and explanations would forbid a pessimistic view being taken. With barely two decades of continuous existence, the industry is still so young that, taken as a whole, it may be spoken of as being even yet in its formative period, and a nascent period is almost invariably one of unavoidable waste and extravagance. However, a great deal of experimental work has doubtless been done once for all.

These statistics show another phase of the general tendency to inflation by overcapitalization upon the basis of large earnings in good times, with the result that a large part of the nominal capitalization is unable to pay dividends, while the rates for the sale and supply of current, etc., are often kept unnecessarily high. Those familiar with the history and development of the central station industry are aware of the prolonged and expensive period of reconstruction that has led up to the present era of modernized stations, which, even as they stand, do not in many respects represent finality, but in frequent instances will at an early date have to pass into the scrap heap under the pressure of competition or on account of the production of apparatus of such superior efficiency and economy that no manager would consider he was doing his duty if he did not immediately adopt it. In the technical part of this report various aspects of this evolution in central station work will be more minutely considered. It will suffice here to note in connection with questions of capitalization, that since most of the central stations have been, until recent years, almost entirely lacking in a proper depreciation account, the frequent reconstruction and renewals of their systems have necessarily been charged to the capital account. Instances could be cited from some of the largest stations in the country where, as a result of inevitable changes in the system, apparatus for which the average rate of depreciation might be 4 or 5 per cent per annum has been thrown out or disposed of for a nominal sum at the end of four or five years, so that even had there been a depreciation account and a scientific method of "writing off," the newer additions to the plant would be under the burden of maintaining the business of the company and earning its entire income from operation without the aid of the older plant still carried on the books, and equally represented in the capital account. In this connection it might also be pointed out that some corporations, organized to take over central stations, have been capitalized rather on the basis of future earnings than on the actual earning capacity at the time of the reorganization.

Preliminary expenses provided for out of capitalization.—It is only fair to the corporations whose reports are under review to note also the fact that although the cost of construction and equipment has been compared with the capitalization with the result of revealing generally a gap between the two, the mere compilation of the items entering into the physical constitution of a central station is very far from doing justice to all the elements that go to make up such an industry, whether as an investment or as a specimen of engineering. It is needless to allude to the preliminary work—often very expensive and laborious—connected with the organization of the company and the securing of necessary legislation, franchises, rights of way, concessions, and other moves that have to be made before the company can come into being as a creation of the state and a servant of the public. The central station is, however, much more than a financial corporation, and it is upon the preliminary engineering in its work that a large amount of expense is concentrated. This fact is not usually a matter of public information. Among such items might be mentioned the careful and elaborate canvass that it is the custom to make in order to ascertain how much current, how many lights, and how much capacity in horsepower of motors are likely to be called for in the area to be served. Upon the results of the canvass depend not only the amount of capital required and the magnitude of the plant as to the machinery to be installed and the buildings to be put up, but also the size and length of the circuits, whether overhead or underground. It can readily be seen that these determinations are vital to the success of the proposed enterprise, and hence they are made and remade with care which involves a large amount of thought, time, and expense. These remarks are equally true of the central station itself in its equipment and design, and in the decision to adopt or reject certain features upon the best engineering advice. Work of this character must be provided for out of the original capitalization of the company, and such work must also be renewed incessantly after the plant has gone into operation, although at the later stage it can properly be and often is paid for out of the income.

The practice of electric light companies, as well as those engaged in kindred enterprises, varies as to the amount that is properly chargeable to capital account and the amount that should be included under operating expenses and ordinary repairs. Undoubtedly some of the

companies included in these returns have placed themselves in the best position to meet the inevitable reconstruction expenses of their business by making such outlay out of current income, although they thereby lower their rate of dividends and perhaps the public quotations of their stock, rather than by maintaining a high rate of dividends and loading on the ultimate capital account, items which in the aggregate represent a large amount of money and upon which from year to year a larger amount of dividends must be paid.

Capital stock and funded debt, by states.—An examination of the statistics as to capital stock and funded debt for the different states, as shown in Table 69, is instructive, and brings out some interesting points.

The state of New York, as would naturally be expected, stands out conspicuously because of its large proportion of both stocks and bonds issued. It had a total value of $190,300,149, of which $104,245,475 was the value of the capital stock, upon which $682,245 was paid in dividends; and $86,054,674 was the amount of funded debt, upon which $4,195,105 was paid as interest. This amount of slightly over $190,000,000 is more than 30 per cent of the total for the whole country, although the plant and income are by no means in such high ratio. The very large amount of stock, which is almost entirely of the common class, and the small amount of return upon it, are explained chiefly by the fact that in the successive absorptions and consolidations of the lighting interests in Greater New York, stock has been issued in large volume in connection with these transfers of property, and a very small proportion of it had attained the dividend paying basis at the time when the returns were made.

The total par value of the capital stocks and bonds reported for the state of Pennsylvania was $78,636,619, of which $41,147,450 was capital stock, which paid $679,808 in dividends; and $37,489,169 was bonds, on which interest was paid to the amount of $1,736,324.

The value for New Jersey was $58,844,336, of which $31,174,836 was the value of stock, paying the extraordinarily small amount of $27,080 in dividends; and $27,669,500 was the value of the bonds, paying $1,200,937 in interest. The conditions as to stock issuance in New Jersey would appear to have been governed by the remarkable series of changes and transfers in the northern part of the state which vested in the Public Service Corporation both the electric light and the electric railway system throughout a district that is perhaps the largest in the world to be thus occupied and supplied by one management.

The amount issued in the state of California was $51,058,045, of which $36,897,745 was stock, on which $664,721 was paid in dividends; and $14,160,300 was bonds, on which $691,701 was paid in interest.

In Illinois $35,889,835 had been issued, of which $20,789,535 was stock, on which $579,714 was paid in dividends; and $15,100,300 was bonds, on which $738,977 was paid in interest.

In Ohio the total was $24,839,632, of which $19,299,799 was stock, on which $575,123 was paid in dividends; and $5,539,833 was bonds, on which $266,459 was paid in interest.

The state of Massachusetts furnishes a striking example of the practice of maintaining a fairly good rate of return on stock and keeping the amount of bonds low. The total issue was reported at $21,412,506, of which $16,971,000 was for stock, upon which not less than $1,225,129 was paid in dividends, this being by far the largest amount returned as dividends on stock in any state; while the value of bonds was $4,441,506, on which $247,015 was paid as interest.

Stocks and bonds held by parent companies.—To a large extent the stocks and bonds of these various enterprises are held locally, but no data were obtained on this point. In the initial days of the introduction of electric lighting it was the general practice with the "parent companies," by which name the concerns selling the plant were known, to issue a license for a given city or territory and to take in return for its apparatus and its patent license a certain proportion of stocks and bonds of the local company organized. Hundreds of companies were started on this basis, a part of the capitalization being held at home, while part of it went to the parent companies and was bought from them by bankers. Down to the period included in this report a few of the parent companies continued to hold blocks of stock and bonds obtained originally in this manner; but the practice, which was so universal at one time, has almost entirely died out, and the securities have now passed into the hands of the general public. Boston, New York, Philadelphia, Pittsburg, Cleveland, and Chicago are the principal centers at which such securities have been marketed, and these cities have exchanges upon which such stocks are still most largely listed and where quotations are most readily obtainable. While it would be of great interest to know what net valuation at current market prices was represented by the figures cited above, it is impossible to determine this, because in a great many cases the stocks and bonds of the companies under consideration were not listed or quoted regularly upon any of the exchanges or even dealt in casually on the "curb" or unlisted market.

During the past few years a large number of companies, individually small and not subject to stock exchange valuations, have been brought more readily within the area of open public investment and of financial adjudication as to actual value by the action and formation of large holding companies located chiefly in the cities that have already been mentioned. These holding companies, whose operations are on the increase, make it their business to buy up lighting plants either in selected regions of great extent or through the country promiscuously, when the operators of the

plants are not able to furnish the necessary capital for maintaining and extending the system. When plants are thus brought under one management all the supplies for them are bought in common, and consequently are cheaper; the employees are subject to sharper discipline, and the engineering supervision is more careful than in the separate plants; therefore the plants, as a whole, are likely to be in much better condition and also much more progressive than they were as scattered units in struggling communities. Another advantage gained is that the securities issued in exchange for the stocks, or to raise the money to pay for them, are regularly listed and largely dealt in on prominent exchanges. The same system has been pushed even farther in the combination of electric railways and electric lighting stations, as well as other enterprises of an electric nature; and it remains to be seen how far and how beneficially this tendency can be carried. Its ultimate result will constitute undoubtedly an important chapter of American economic development.

Bonds of municipal stations.—Of the 815 municipal stations enumerated, 656, with an authorized funded debt of $12,625,482, reported $11,609,488 in bonds outstanding. Of these municipalities, 635 reported the payment of interest amounting to $504,805 on bonds to the value of $11,239,588, the average rate being 4.5 per cent on all bonds paying interest. It is to be observed that this rate very closely approximates that paid by the private companies, namely, 4.8 per cent. As a general thing, the rate on funded debt for municipalities is understood to be lower than that which can be obtained by private companies, and this has frequently been advanced as an argument for placing a plant under municipal ownership, since it is reasoned that a cheaper and more economical administration may be obtained thereby. The cost of construction and equipment of the municipal stations is set down as $22,020,473, although it is not to be inferred or understood that the wide difference between the cost of construction and equipment and bonds outstanding is represented by the figures for the 159 plants not reporting bonds outstanding; moreover, no statement is made as to the value of the bonds that were originally authorized and issued for the construction or acquisition of such plants and have since been liquidated and retired.

The largest amount of bonds outstanding for municipal stations was for the state of Michigan, and resulted to a great extent from the large station at Detroit; the amount was $1,833,850, and a total of $79,249 was paid in interest.

II.

COST OF CONSTRUCTION AND EQUIPMENT.

General discussion—private stations.—The cost of construction and equipment as reported for private stations is given by states and territories in Table 69. Similar statistics are shown in Table 79 for the stations owned by municipalities. It should be understood before coming to a discussion of the capital stock and funded debt outstanding in relation to cost of construction and equipment that the capitalization may or may not represent an actual investment of capital. In many instances the stock is not fully paid. The schedule used in collecting statistics from central stations included a series of questions concerning the cost of construction and equipment. The object of these questions was, in part, to distinguish the amount expended annually for the physical maintenance and extension of the system. These questions required separate amounts to be reported for each of the following items: Land, buildings, machinery, tools and implements within stations, electric service construction, lamps, motors, meters, and transformers wired for use, supplies of every kind on hand not enumerated in these items, and miscellaneous. A large number of stations reported that it was impossible to give an itemized statement of this kind, especially where the station was installed and operated in connection with other enterprises or where the present corporation did not build and equip the plant, but purchased it as a whole. Hence, in Table 69, only the total cost to date and for the year are shown, the latter item throwing some interesting light upon the amount of extension and new work occurring during a period of twelve months. The cost of construction and equipment of private stations constituted 95.6 per cent and that of municipal stations, only 4.4 per cent of the total amount, namely, $504,740,352, reported for all stations.

Cost of construction during the year—private stations.—According to the reports received, private stations expended $40,050,613 and municipal plants $1,741,834 in construction and equipment during the year covered by the reports.

A study of Table 69 exhibits some striking variations in the different states as to the amount of expenditure during the year under the head of construction and equipment, the item bearing apparently no relation to the figures which have been discussed as to population and investment, or in general as to equipment. The reason for this is doubtless to be found in the fact that great extensions are rarely made in all the states simultaneously. If they were all to be carried on at once, the electrical manufacturing industry would be under abnormal pressure in some years and would be correspondingly dull in other years. Hence, while the total amounts for the various years may average about the same, considering the natural tendency to increase, the analysis of the amounts would show development to vary from one state to another, year by year, and more particularly from one large city to another. Thus the amount expended for construction and equipment during the year in Pennsylvania was only $3,057,799,

almost exactly the same amount being expended in Illinois, namely, $3,074,117. It is a matter of record that since that time very heavy investments in plants, buildings, etc., have been made in Chicago and in Philadelphia. Massachusetts reported no less than $8,343,437, although the total for the industry from the beginning was only $28,335,006. This was by far the largest amount expended in any state, and would indicate a period of unparalleled activity, with new work going on in almost every community. It was almost twice the amount spent in the state of New York, $4,955,859, and was much larger, also, than the amount spent in California, $5,210,395, where a considerable development was also taking place. Other states in which especial activity during the year was indicated are Iowa, New Jersey, Ohio, Rhode Island, Missouri, Colorado, Texas, and Montana.

Unit of comparison.—In discussing the financial statistics of central electric light stations, it is by no means easy to find a unit of comparison for the ratio of investment, capitalization, etc. With railways of all kinds one basis of computation is the mileage of track, and a variety of interesting and instructive figures can be worked out upon that basis (sufficient for certain purposes, if checked by other bases and ratios). So far as is known, however, it is impossible to use as a unit of capitalization or investment the miles of circuit which a central station may have installed or with which it may be connected. In fact, outside the mileage of its mains and feeders, it may be questioned whether any large central station management has any except the most general idea as to the miles of wire over which the current it generates may be circulated. In cities of even the most moderate size, it is now the practice to wire new buildings for electric light and service in the same matter-of-course way as they are piped for gas or water supply. It is also true that new factories are planned in such a way that individual tools and whole rooms of machinery may be operated by electric motors, and the circuits must be connected with these motors also. Hence, while the electric light company must know how many lamps or how much horsepower of motors there are in its circuit, i. e., how much apparatus it is contracting to operate, it hardly ever raises the question as to how many miles of circuit there may be in the new service for which it has taken the order. It assumes as a matter of course that the building has been adequately wired, and, in fact, as the current supplied is now metered rather than sold at a flat rate, and as the meters are placed at the entrances to the buildings, the supplying company would be the gainer in the consumption of current if the wire was inadequate in size and if an undue amount of current was therefore consumed in overcoming the disproportionate resistance. Moreover, the proprietor of the building with insufficient wiring would be assuming improper hazards as to the risk of fire. Any consideration, therefore, of electric light capitalization as related to the total mileage of circuit may be dismissed as out of the question.

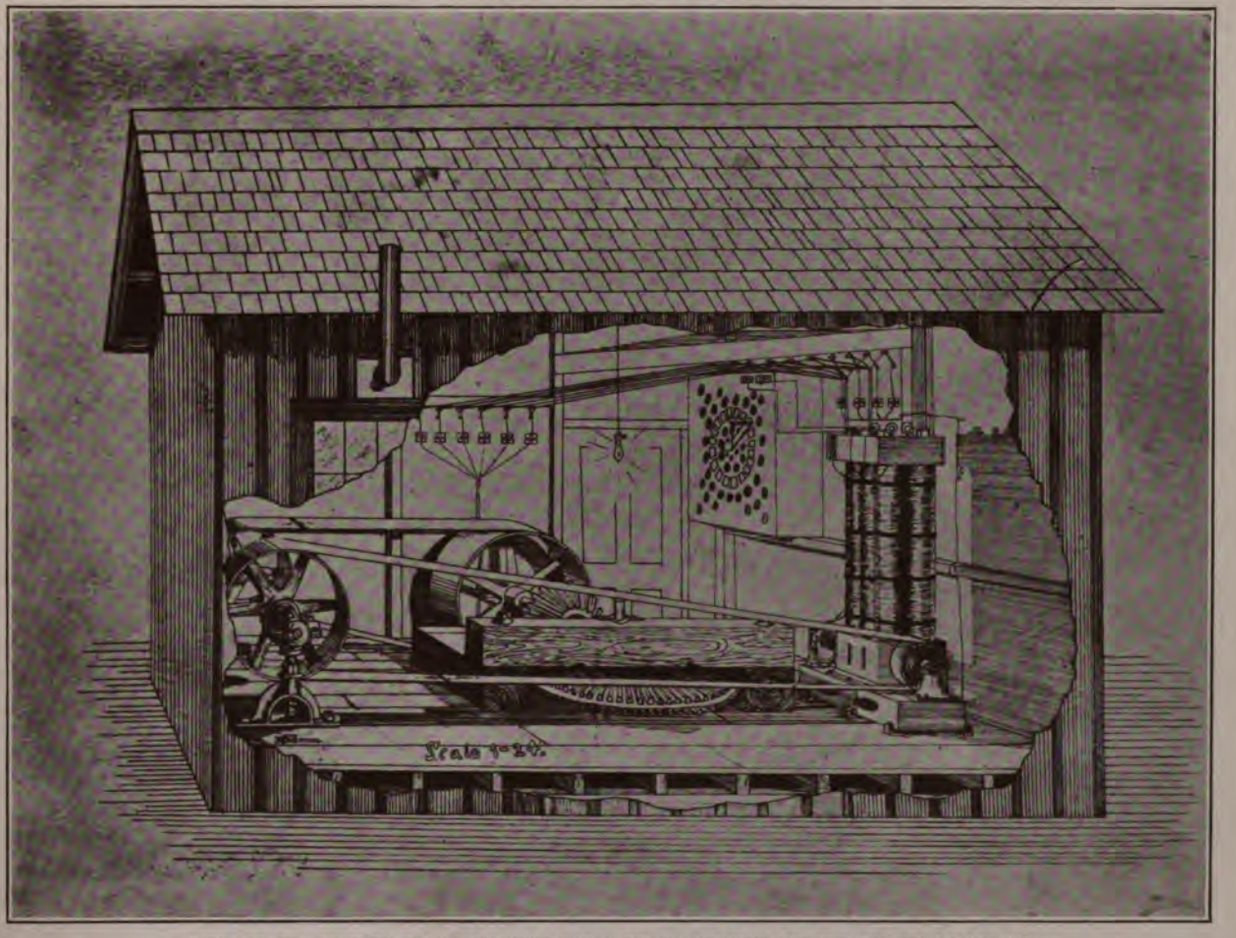
A test based upon the number of lamps and motors connected is equally invalid, since such figures have more to do with the question of earning capacity and average income than with the investment required or the outlay sustained for the equipment of the power plant and the system as a whole. A rough and ready unit of comparison—though one not to be taken too seriously—is that based upon the horsepower equipment or generating capacity of the central station itself, and from this some interesting data may be derived.

A moment's thought will show that a large part of the outlay on a central station system must necessarily be expended for work outside the four walls of the power house, and that the amount so expended will vary with a number of uncertain factors, particularly those connected with the construction of the distributing circuits. In some cases the circuits are overhead, in others they are underground, and in others, again, there are circuits of both kinds, and as a rule the cost is not the same in any two cases. Among electric engineers and purchasers of dynamo-electric apparatus, it is customary to quote offhand general figures as to the cost per kilowatt of such machinery in the market, but in reality the figures of expense differ according to a variety of important and essential elements, such as the size of the plant, its nature, whether steam or hydraulic, the provision for development and extension, the reserve capacity deemed necessary, the location of the plant, and its accessibility for the delivery of machinery or fuel. It must be understood, therefore, that the total cost embraces these various items and other miscellaneous equipment, the buildings, the cost of constructing overhead and underground circuits, the switchboards in the power house, the substations, and other features without which the plant could not be operated.

Cost of construction and equipment of private stations.—The private stations reported a total dynamo capacity of 1,472,996 horsepower. How much of this was actually in use or available is not known, but for the present purposes it will be assumed that all was available. The total cost of construction and equipment for these stations was $482,719,879. This would give an average outlay of $328 per horsepower of dynamo capacity.

Associating the figures of generating equipment in Table 74 with those of cost of construction and equipment in Table 69, conclusions of the same nature are deduced for several of the states. Thus in New York, with a total cost of construction and equipment of $112,185,829, the dynamo capacity was 245,823 horse-

EXTERIOR OF FIRST EDISON STATION, APPLETON, WIS., 1882.



INTERIOR OF APPLETON PLANT, SHOWING EARLY EDISON DYNAMO AND REGULATING APPARATUS.

Original capacity of the plant only 250 incandescent lamps; plant driven by waterpower. Facsimile reproduction of an old engraving.

power. This gives an average of $456 per horsepower. This average is greatly exceeded by that for the state of New Jersey, where there are no centers of population of the first class, and where, presumably, the cost of installation, regular equipment, real estate, and other items would hardly compare with those in New York. In New Jersey the average was $932 per horsepower. This is an abnormal average, and is presumably accounted for by the fact that a number of the stations have changed ownership, the new owners reporting as the cost of construction and equipment the par value of the stocks and bonds issued in payment, regardless of their market value. The adjacent state of Pennsylvania, although containing the two large cities of Philadelphia and Pittsburg, fell far below either New York or New Jersey, reporting an average of $260 per horsepower. In a number of states the average approximated that for the country as a whole, namely: California, $327; Colorado, $297; Connecticut, $318; Illinois, $314; and Ohio, $320. The average was low for all of the Southern states, except Louisiana, for which it was $644. This high average was probably due to the same causes as those existing in New Jersey.

Cost of construction and equipment of municipal stations.—The statistics of cost have thus far been discussed solely with regard to the central stations operated by private companies. It is only with them that questions connected with capitalization would arise from the standpoint of investment, returns, capacity, etc. It may not be amiss, however, to note incidentally a few of the figures connected with the municipal stations.

Without going into the minute details of an examination of each station, it would be difficult to determine how much of the cost of construction and equipment pertained to what may be spoken of as "live plant," that is, apparatus in present use as distinguished from that which has passed out of service and therefore has no longer a capital value or earning capacity. It appears from the statistics in Table 79 that the cost of the construction and equipment of municipal stations from their origin until 1902 was $22,020,473, while the total dynamo capacity shown in Table 84 was 151,984 horsepower. This would represent an average of nearly $145 per horsepower of generating capacity as the cost of construction and equipment of the plants as they stood at the time of the report. The difficulty of taking this figure as the basis for comparison is shown by the wide variations revealed by the different states in regard to these plants. In the state of Washington, for example, the average was $844 per horsepower, while in Connecticut it was $260, and in California, $210. No other state approximated these figures, although Massachusetts with $187 and Michigan with $175 were considerably above the average. In both New York and Pennsylvania an average of $156 per horsepower prevailed. In Wisconsin and Iowa the average was $132; in Minnesota, $139; in Missouri, $143; and in Illinois, $154. In Ohio and Indiana the averages were considerably below that for the country, that in the former being $114 and in the latter $116 per horsepower.

III.

GENERAL DISCUSSION OF INCOME AND EXPENSES.

Basis of income.—The method of carrying on the business of central stations varied not only with the section of country but with the idiosyncrasies of individual stations, and therefore it was impossible to obtain all the information necessary to prepare an exact income account for the generation and sale of electric current exclusively. It is only within recent years that the distinction between income from sale of current and other income has arisen and has been recognized by central station managers.

At the outset the central station companies undertook to do merely the work connected with lighting—then their sole basis of income—and it is only within a quite recent period that the function of a central station has been regarded as dealing with the supply and sale of current irrespective of the use to which that current may be put and of the apparatus consuming it. Even at the present time it is not well settled among them whether they are selling current for light only or for a variety of uses. But there can be no question as to the fact that as the central station industry expands the managers of a company care less for any particular branch of it, and devote their energies more and more to the efficient generation of current and its economical distribution, leaving it to the consumer to determine to what specific use the current shall be put.

None of the early central stations metered the current, but sold it on a flat rate basis, charging so much per year, per month, or per night for an arc or an incandescent lamp. The conditions of operation rendered it comparatively easy to conduct the enterprise on that happy-go-lucky plan, as the business was restricted almost entirely to arc lighting, the lamps being lighted at a certain hour in the evening and allowed to burn for a definite number of hours, so that the amount of current and service could be roughly estimated. When the incandescent lamp was added to the consumption circuits the attempt was made to place this similarly on an arbitrary scale, predicated upon the number of lamps in the house or building and the plausible number of hours that such lamps might be used. Even to-day, as will be seen later in the discussion of incandescent lighting, such methods are still in vogue. It was soon found, however, especially when electric motors and lamps were employed on the same mains, that the central station must employ a more scientific basis for deter-

mining its income. This led to the invention and perfection of numerous station and house meters for measuring electric current, and these meters were quite generally introduced by all the large stations, so that the tendency of the last few years has been toward the metering of all current and making charges for it upon the basis of the number of units consumed, subject to varying rates of discount or to varying methods of encouraging the customers to patronize the service largely. In this respect electric current supply has been rapidly placed abreast of gas, and as a general thing the charges for both services would appear to be far more precise and accurate than those under the centralized distribution system, which is older than either of them and is used in connection with the supply of water from a common reservoir.

The reports for 380 stations show that some service in the character of a tax was furnished to the municipalities in which they were located. This tribute consisted in the illumination of some or all of the public buildings, the supply of a certain number of lamps, the granting of a special discount on the lamps used by the municipality, or in other ways making a return for the ordinance or franchise by which the private company was granted the right to use the streets. The value of this free service has been estimated at commercial rates, and is included in the income. In some instances a cash compensation of a certain specific amount or a proportion of the gross income was required as a yearly payment. For the census year, 89 stations reported a payment of this character.

Miscellaneous income.—In addition to the income derived from the sale of current for lighting purposes, a considerable amount was received from "all other electric service," which included stationary motor service, railway motor service, electric heating, charging automobiles, etc., and a comparatively small amount from "all other sources," which included the renting of motors, meters, and conduits, the sale of steam and water power, the wiring of houses, the sale of supplies, pumping, steam heating, hot water heating, interest on deposits, and a variety of miscellaneous work. In some cases the stations still do a considerable commercial business of this character, the practice varying greatly, however, in this respect. The pioneer stations, in the absence of the contracting and installing electric firms now so numerous, were compelled to do the bulk, if not all, of their own construction work, but to-day every large city and indeed every community of fair size has its construction and supply house for electric work, to which is relegated to an increasing degree all work beyond that of generating current. Some of the stations included in this report do a considerable construction and supply business, in such a way as to render it out of the question to segregate the incidental expenses so as to show the cost of station supplies used, as distinguished from those sold commercially.

General statistics of income.—Table 12 gives a condensed summary of the income from the various sources, and shows the totals for the United States and the amounts for private and municipal stations with the percentage which each is of the total. In the case of municipal stations, as already noted, the income from public service was necessarily estimated.

TABLE 12.—*Income—private and municipal stations, and percentage each class is of total: 1902.*

	Total.	PRIVATE STATIONS.		MUNICIPAL STATIONS.	
		Amount.	Per cent.	Amount.	Per cent.
Total	[1] $85,700,605	$78,735,500	91.9	[1] $6,965,105	8.1
Arc lighting	[1] 25,481,045	22,091,800	86.7	[1] 3,389,245	13.3
Incandescent lighting	[1] 44,657,102	41,297,484	92.5	[1] 3,359,618	7.5
All other electric service	14,048,458	13,960,465	99.4	87,993	0.6
All other sources	1,514,000	1,385,751	91.5	128,249	8.5

[1] Includes estimated income from public lighting.

Of the total income, $85,700,605, not less than $78,735,500, or 91.9 per cent, was reported for private stations and $6,965,105, or 8.1 per cent, for municipal stations. The rate of income of private stations exceeded this rate in all branches of electric service except arc lighting, for which the private stations reported only 86.7 per cent of the total.

Table 13 shows the percentages that the receipts from the different sources form of the total income for all stations and for private and municipal stations, respectively.

TABLE 13.—*Percentage that each item of income is of total—private and municipal stations: 1902.*

	Total.	Private stations.	Municipal stations.
Total	100.0	100.0	100.0
Arc lighting	29.7	28.1	48.7
Incandescent lighting	52.1	52.4	48.2
All other electric service	16.4	17.7	1.3
All other sources	1.8	1.8	1.8

Although the practice of supplying current for motive power and other uses had grown rapidly, the supplying of current for light was still preponderatingly the business of both private and municipal stations. Of the total income, $70,138,147, or 81.8 per cent, was directly derivable from lighting. The private stations obtained 80.5 per cent and the municipal stations 96.9 per cent of their income from this source.

General statistics of expenses.—The amounts expended for salaries, wages, supplies, materials, fuel, and miscellaneous expenses are given by states in Tables 70 to 72 and 80 to 82. The totals are presented in Table 14, which shows also the proportion represented by private and municipal stations, respectively. These comprehensive divisions of expense will be analyzed later.

TABLE 14.—*Expenses—private and municipal stations, and percentage each class is of total: 1902.*

	Total.	PRIVATE STATIONS.		MUNICIPAL STATIONS.	
		Amount.	Per cent.	Amount.	Per cent.
Total	$68,081,375	$62,835,388	92.3	$5,245,987	7.7
Salaries and wages	20,646,692	18,766,970	90.9	1,879,722	9.1
Cost of supplies, materials, and fuel	22,915,932	20,493,641	89.4	2,422,291	10.6
Rents, taxes, insurance, and miscellaneous expenses	11,895,206	11,456,037	96.3	439,169	3.7
Interest on bonds	12,623,545	12,118,740	96.0	504,805	4.0

Table 15 shows the percentage that each of the main divisions of expense is of the total for all stations and for private and municipal stations, respectively.

TABLE 15.—*Percentage that each item of expense is of total—private and municipal stations: 1902.*

	Total.	Private stations.	Municipal stations.
Total	100.0	100.0	100.0
Salaries and wages	30.3	29.9	35.8
Cost of supplies, materials, and fuel	33.7	32.6	46.2
Rents, taxes, insurance, and miscellaneous expenses	17.5	18.2	8.4
Interest on bonds	18.5	19.3	9.6

The percentages shown in Table 15 vary greatly for private and municipal stations. In private stations the salaries and wages were 29.9 per cent, while in municipal stations they were 35.8 per cent of the total expense. In private stations the supplies, materials, and fuel were 32.6 per cent, and in municipal stations, 46.2 per cent. In private stations the rents, taxes, insurance, and miscellaneous expenses were 18.2 per cent, and in municipal stations 8.4 per cent. In private stations the interest on bonds was 19.3 per cent, while in municipal stations it was only 9.6 per cent.

It is highly probable that in many cases municipal stations failed to report closely rents, insurance, taxes, and other miscellaneous expenses, because they would be included in a general account for other public works, and it would be impossible to make an exact or equable division. The interest on bonds is relatively small, largely because many of the bonds issued to purchase or construct stations have been paid and retired.

Income and expenses of stations, classified according to population of places in which located.—It has already been explained that a large number of the central stations of the country are engaged in other business than merely that of electric lighting. As stated on page 5, the stations have been classified with regard to their specific work and also with regard to population of places in which located and capacity of plant. Tables 16 to 23 deal with various aspects of the income and expenses, as well as some general statistics, thus considered. Tables 16 and 17 present the income and expenses of purely electric and composite private stations, respectively, classified according to the population of the places in which located. Tables 18 and 19 show similar statistics for municipal stations. Tables 20 and 21 deal with income and expenses of private stations, classified according to the horsepower capacity of their dynamos, while Tables 22 and 23 give the two classes of municipal stations on the same basis.

TABLE 16.—INCOME AND EXPENSES—PURELY ELECTRIC PRIVATE STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	1,759	1,345	277	76	44	17
Cost of construction and equipment	$320,580,333	$42,307,091	$45,951,671	$49,257,859	$98,259,566	$84,804,146
Gross income	$54,455,737	$9,654,207	$7,840,871	$8,521,413	$11,445,572	$16,993,674
Income from sale of current	$53,394,158	$9,413,217	$7,608,688	$8,208,964	$11,212,655	$16,950,634
Arc lighting	$14,721,531	$1,784,903	$1,870,485	$2,457,083	$3,502,671	$5,106,389
Incandescent lighting	$28,082,469	$6,512,620	$3,562,386	$4,013,412	$5,055,736	$8,938,315
All other electric service	$10,590,158	$1,115,694	$2,175,817	$1,738,469	$2,654,248	$2,905,930
Income from all other sources	$1,061,579	$240,990	$232,183	$312,449	$232,917	$43,040
Total expenses	$43,292,764	$7,411,951	$6,290,796	$6,223,741	$8,710,377	$14,655,899
Salaries and wages	$12,776,849	$2,696,664	$1,956,675	$1,800,245	$2,431,439	$3,891,826
Cost of supplies and materials	$5,625,812	$1,061,180	$682,743	$987,094	$952,611	$1,942,184
Cost of fuel	$6,652,316	$1,682,280	$1,003,960	$1,067,900	$1,289,682	$1,608,494
Rent of power	$1,416,858	$265,328	$302,910	$337,292	$504,128	$7,200
Rents, taxes, insurance, and miscellaneous	$8,053,677	$1,110,659	$1,060,194	$1,251,355	$1,654,526	$2,976,943
Interest on bonds	$8,767,252	$595,840	$1,284,314	$779,855	$1,877,991	$4,229,252
Salaried officials and clerks:						
Number	3,765	1,298	725	456	551	735
Salaries	$3,507,953	$829,383	$579,030	$503,165	$732,377	$863,998
Wage-earners:						
Average number	13,976	3,261	2,199	1,895	2,581	4,040
Wages	$9,268,896	$1,867,281	$1,377,645	$1,297,080	$1,699,062	$3,027,828

It will be seen from Table 16 that the 1,759 purely electric private stations represented a cost of construction and equipment of $320,580,333, and derived from the sale of current and all other sources a gross income of $54,455,737, against which there were expenses chargeable of $43,292,764. The items of income and expenses are shown in the table. These stations employed 3,765 officials drawing salaries of $3,507,953, and 13,976 wage-earners to whom were paid wages amounting to $9,268,896.

The grouping by population shows that the 61 stations in cities with a population of 100,000 and upward represented a cost of construction and equipment of $183,063,712, while the remaining 1,698 stations represented a cost of construction and equipment of only $137,516,621. By far the largest class is that associated with places of less than 5,000 inhabitants, there being 1,345 such stations. A somewhat significant fact as to the general contention that in the smaller communities it is advisable and desirous to consolidate enterprises in different fields of public service, so as to secure the highest economy and efficiency by concentration of effort, is that 1,345 stations, with a gross income of $9,654,207, required 1,298 officials drawing $829,383 in salaries, while the 17 stations in cities having a population of 500,000 and over, with a gross income of $16,993,674, found it necessary to employ only 735 salaried officials and clerks drawing $863,998; moreover, the 1,345 stations required 3,261 wage-earners, while the 17 stations, with earnings almost double, required only 4,040. The rate of wages paid, however, is much higher in the group reported for large cities, where the wages amounted to $3,027,828, while in the other case it was $1,867,281, the respective figures per capita per annum being about $749 and $572.

TABLE 17.—INCOME AND EXPENSES—COMPOSITE PRIVATE STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	1,046	698	277	39	23	9
Cost of construction and equipment	$162,139,546	$18,411,443	$52,758,274	$19,515,289	$47,431,581	$24,022,959
Gross income	$24,279,763	$4,340,587	$7,317,687	$3,803,482	$5,537,380	$3,280,627
Income from sale of current	$23,955,591	$4,243,785	$7,170,897	$3,759,866	$5,504,800	$3,276,243
Arc lighting	$7,370,269	$878,602	$2,393,938	$1,333,139	$2,113,129	$651,461
Incandescent lighting	$13,215,015	$3,066,862	$3,779,997	$1,941,962	$2,387,984	$2,038,210
All other electric service	$3,370,307	$298,321	$996,962	$484,765	$1,003,687	$586,572
Income from all other sources	$324,172	$96,802	$146,790	$43,616	$32,580	$4,384
Total expenses	$19,542,624	$3,480,277	$6,033,609	$3,115,057	$4,530,913	$2,382,768
Salaries and wages	$5,990,121	$1,240,157	$1,908,627	$903,639	$1,218,690	$719,008
Cost of supplies and materials	$2,670,951	$484,494	$783,737	$379,882	$664,492	$358,346
Cost of fuel	$3,537,369	$821,534	$1,264,702	$446,241	$723,667	$281,225
Rent of power	$590,335	$171,752	$126,002	$155,062	$127,093	$10,426
Rents, taxes, insurance, and miscellaneous	$3,402,360	$500,629	$909,340	$516,806	$942,716	$532,869
Interest on bonds	$3,351,488	$261,711	$1,041,201	$713,427	$854,255	$480,894
Salaried officials and clerks:						
Number	2,281	634	862	258	252	275
Salaries	$1,698,246	$330,923	$553,260	$249,188	$285,911	$278,964
Wage-earners:						
Average number	6,887	1,687	2,231	954	1,405	610
Wages	$4,291,875	$909,234	$1,355,367	$654,451	$932,779	$440,044

Table 17 includes the statistics of 1,046 private stations operated in connection with other business. The cost of construction and equipment of these stations was $162,139,546, the gross income was $24,279,763, and the expenses were $19,542,624. These stations employed 2,281 salaried officials and clerks, who received $1,698,246 in salaries, and 6,887 wage-earners who were paid $4,291,875. Of these composite plants, only 32 were in cities of 100,000 or more inhabitants; only 39 were in cities of a population of between 25,000 and 100,000; 277 were in cities of between 5,000 and 25,000; and 698 were in communities of less than 5,000. The effect of operating more than one kind of business is shown chiefly in the group of 698 small stations, which employed 634 salaried officials and clerks, or less than 1 per station, a palpable indication of the division of executive labor and expense among different departments of the business. The salaries paid these officials amounted to $330,923, or about $522 each, this small average being a further indication of the fact that the income must be brought up to the normal amount for men in such positions by being derived in part from other sources. In the 9 stations of the largest composite class 275 officials were paid $278,964, or about $1,015 each, which reveals a sharper definition of function and with it a better rate of salary. The 698 small stations employed 1,687 wage-earners, or more than 2 per station, and paid in wages $909,234, or almost $539 per employee, while the 9 stations employed 610 men, an average of about 68 per station, and at a rate of slightly over $721 per employee.

It is chiefly in connection with the salaries and wages that the economies of the composite stations are to be looked for, although some advantage should appear in the items of fuel and rent. Earnings from the sale of current by the 1,759 exclusively electric stations were $53,394,158, with a bill for fuel and rented power of $8,069,174. The 1,046 composite stations, with earnings of $23,955,591 from the sale of current, incurred expenses

amounting to $4,127,704 for fuel and rent of power; thus the composite stations, with considerably less than half the earnings, required considerably more than half the amount of outlay for generating current. While this apparent absence of the looked for economy might be due to the lesser magnitude of the station—it being a general truth that the cost of producing power becomes higher as the station decreases in size—it is also possible that in the case of the stations operated in conjunction with other businesses some of the expenses for fuel and power charged against them should properly be debited to the associate industry.

While the private stations that are of a composite character are much fewer in number than the purely electric ones, the municipal stations that are operated in connection with other businesses are somewhat more numerous than those that are purely electric, as might have been expected from the fact that the first argument for the installation of a municipal electric lighting station is that it can be operated to great economical advantage in connection with some other city service, particularly waterworks or gas works.

TABLE 18.—INCOME AND EXPENSES—PURELY ELECTRIC MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	380	288	73	10	6	3
Cost of construction and equipment	$13,571,391	$4,807,586	$3,843,182	$1,334,848	$1,607,803	$1,977,972
Gross income[1]	$4,147,669	$1,526,686	$1,146,261	$378,094	$441,235	$655,393
Income from sale of current[1]	$4,076,439	$1,488,099	$1,127,209	$378,039	$427,699	$655,393
Arc lighting	$2,276,193	$509,982	$602,458	$194,674	$319,186	$649,893
Incandescent lighting	$1,732,235	$959,421	$496,659	$171,228	$99,427	$5,500
All other electric service	$68,011	$18,696	$28,092	$12,137	$9,086	.....
Income from all other sources	$71,230	$38,587	$19,052	$55	$13,536	.....
Total expenses	$3,021,025	$1,238,988	$871,138	$297,720	$295,851	$317,328
Salaries and wages	$1,114,577	$425,356	$321,529	$100,560	$137,319	$129,813
Cost of supplies and materials	$464,938	$196,410	$140,391	$42,526	$38,553	$47,058
Cost of fuel	$781,558	$348,255	$217,534	$56,547	$57,301	$102,921
Rent of power	$104,796	$35,902	$29,902	$38,992	.....	.....
Rents, taxes, insurance, and miscellaneous	$281,197	$103,015	$83,648	$34,565	$22,433	$37,536
Interest on bonds	$273,959	$130,050	$78,134	$25,530	$40,245	.....
Salaried officials and clerks:						
Number	456	271	135	23	17	10
Salaries	$246,280	$119,096	$80,565	$18,818	$18,401	$9,400
Wage-earners:						
Average number	1,412	579	390	132	170	141
Wages	$868,297	$306,260	$240,964	$81,742	$118,918	$120,413

[1] Includes estimated income from public lighting.

TABLE 19.—INCOME AND EXPENSES—COMPOSITE MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	435	383	48	3	.....	1
Cost of construction and equipment	$8,449,082	$6,266,422	$1,761,996	$219,083	.....	$201,581
Gross income[1]	$2,817,436	$2,094,337	$618,739	$77,110	.....	$27,250
Income from sale of current[1]	$2,760,417	$2,050,369	$605,688	$77,110	.....	$27,250
Arc lighting	$1,113,052	$657,479	$368,013	$66,310	.....	$21,250
Incandescent lighting	$1,627,388	$1,382,849	$227,734	$10,800	.....	$6,000
All other electric service	$19,982	$10,041	$9,941	.....	.....	.....
Income from all other sources	$57,019	$43,968	$13,051	.....	.....	.....
Total expenses	$2,224,962	$1,701,610	$452,810	$50,236	.....	$20,306
Salaries and wages	$765,145	$560,894	$175,529	$20,202	.....	$8,520
Cost of supplies and materials	$387,963	$281,660	$96,307	$8,815	.....	$1,181
Cost of fuel	$664,266	$540,168	$111,771	$10,312	.....	$2,015
Rent of power	$18,770	$9,064	$1,206	.....	.....	$8,500
Rents, taxes, insurance, and miscellaneous	$157,972	$119,443	$34,819	$3,620	.....	$90
Interest on bonds	$230,846	$190,381	$33,178	$7,287	.....	.....
Salaried officials and clerks:						
Number	494	419	72	1	.....	2
Salaries	$211,101	$175,193	$33,088	$300	.....	$2,520
Wage-earners:						
Average number	1,055	780	240	27	.....	8
Wages	$554,044	$385,701	$142,441	$19,902	.....	$6,000

[1] Includes estimated income from public lighting.

Of the 815 municipal stations included in Tables 18 and 19, 435 are shown to be composite in character and 380 purely electric. As with the private stations, the purely electric plants represent a larger cost of construction and equipment, the amount being $13,571,391, with a gross income of $4,147,669 and expenses of $3,021,025. The 435 composite plants represent a cost of construction and equipment of $8,449,082, with a gross income from all sources of $2,817,436 and expenses of $2,224,962. The 456 salaried officials in the

purely electric stations were paid $246,280, while the 494 in the composite group were paid $211,101, the rates being $540 and $427, respectively. In both cases these rates fall below the corresponding rates for private stations, but it should be borne in mind that while the station may be exclusively electric the salaried officials may be engaged on some other municipal work from which they derive an income. In the composite stations, especially, the salaries are apt to be made up from other sources. Here, again, there is danger of drawing wrong inferences from the figures, as shown by the fact that in the three composite stations with a generating capacity of 500 to 1,000 horsepower, there was an average of only one salaried employee per station and he received only $366 a year, although the stations represented a cost of construction and equipment of $288,913 and had an income of $77,154, with expenses of $44,875. It stands to reason that both the number of salaried officials and the amount of salaries are subject to a finer analysis on account of the unequal distribution or allocation in connection with the other businesses, although the Bureau of the Census in every case did its best to secure a proper division of items bearing upon the subject, and the figures cited are doubtless those upon which the local lighting budgets were made up.

Income and expenses of stations, classified according to dynamo capacity.—Tables 20 and 21 indicate in a general way the greater magnitude of the purely electric private stations, as compared with the composite stations.

TABLE 20.—INCOME AND EXPENSES—PURELY ELECTRIC PRIVATE STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.	2,000 but under 5,000.	5,000 and over.
Number of stations	1,759	1,026	445	121	78	56	33
Cost of construction and equipment	$320,580,333	$16,424,851	$21,754,260	$16,190,380	$25,575,349	$50,117,445	$190,518,048
Gross income	$54,455,737	$4,999,517	$5,582,411	$3,585,065	$6,102,347	$8,639,398	$26,546,999
Income from sale of current	$53,394,158	$4,852,472	$5,393,390	$3,518,423	$4,937,700	$8,406,143	$26,286,030
Arc lighting	$14,721,531	$1,036,360	$1,371,498	$988,447	$1,563,861	$2,507,585	$7,253,780
Incandescent lighting	$28,082,469	$3,711,212	$3,688,358	$1,988,136	$2,378,876	$3,617,887	$12,698,000
All other electric service	$10,590,158	$104,900	$333,534	$541,840	$994,963	$2,280,671	$6,334,250
Income from all other sources	$1,061,579	$147,045	$189,021	$66,642	$164,647	$233,255	$260,969
Total expenses	$43,292,764	$3,792,323	$4,348,944	$2,860,230	$3,804,941	$6,298,486	$22,187,840
Salaries and wages	$12,776,849	$1,389,779	$1,570,850	$924,202	$1,202,748	$1,838,489	$5,850,781
Cost of supplies and materials	$5,625,812	$591,534	$692,939	$390,812	$482,416	$823,049	$2,645,062
Cost of fuel	$6,652,316	$965,778	$937,729	$583,165	$738,811	$999,111	$2,427,722
Rent of power	$1,416,858	$209,879	$179,182	$160,219	$159,486	$327,092	$381,000
Rents, taxes, insurance, and miscellaneous	$8,053,677	$539,403	$660,356	$529,568	$733,941	$1,326,627	$4,263,782
Interest on bonds	$8,767,252	$95,950	$307,888	$272,264	$487,539	$984,118	$6,619,493
Salaried officials and clerks:							
Number	3,765[a]	743	757	348	346	410	1,161
Salaries	$3,507,953	$395,123	$495,244	$269,799	$356,122	$540,081	$1,451,584
Wage-earners:							
Average number	13,976	1,901	1,818	1,005	1,268	2,026	5,958
Wages	$9,268,896	$994,656	$1,075,606	$654,403	$846,626	$1,298,408	$4,399,197

TABLE 21.—INCOME AND EXPENSES—COMPOSITE PRIVATE STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.	2,000 but under 5,000.	5,000 and over.
Number of stations	1,046	624	255	80	48	25	14
Cost of construction and equipment	$162,139,546	$10,157,397	$15,809,884	$14,701,895	$17,727,955	$32,066,942	$71,675,473
Gross income	$24,279,763	$2,925,026	$3,869,430	$2,653,918	$3,353,809	$2,763,537	$8,714,043
Income from sale of current	$23,955,591	$2,873,331	$3,780,444	$2,609,778	$3,304,841	$2,707,360	$8,679,837
Arc lighting	$7,370,269	$672,777	$1,163,709	$850,469	$1,158,251	$848,667	$2,676,396
Incande-cent lighting	$13,215,015	$2,105,263	$2,345,172	$1,397,354	$1,670,560	$1,305,166	$4,391,500
All other electric service	$3,370,307	$95,291	$271,563	$361,955	$476,030	$553,527	$1,611,941
Income from all other sources	$324,172	$51,695	$88,986	$44,140	$48,968	$56,177	$34,206
Total expenses	$19,542,624	$2,388,966	$3,096,647	$2,154,597	$2,619,635	$2,424,918	$6,857,861
Salaries and wages	$5,990,121	$870,767	$1,075,553	$677,097	$806,551	$704,567	$1,855,586
Cost of supplies and materials	$2,670,951	$343,951	$437,115	$296,378	$321,402	$222,094	$1,050,011
Cost of fuel	$3,537,369	$633,227	$643,379	$488,191	$517,248	$390 090	$865,234
Rent of power	$590,335	$93,783	$141,725	$35,691	$125,864	$35,880	$157,392
Rents, taxes, insurance, and miscellaneous	$3,402,360	$316,815	$442,383	$327,521	$457,162	$422,573	$1,435,906
Interest on bonds	$3,351,488	$130,423	$356,492	$329,719	$391,408	$649,714	$1,493,732
Salaried officials and clerks:							
Number	2,281	494	535	259	266	221	506
Salaries	$1,698,246	$234,499	$309,470	$182,287	$225,227	$174,789	$571,974
Wage-earners:							
Average number	6,887	1,265	1,316	771	864	803	1,868
Wages	$4,291,875	$636,268	$766,083	$494,810	$581,324	$529,778	$1,283,612

It will be seen from the groups made on the basis of dynamo capacity that 33 purely electric private stations had dynamos of a capacity of over 5,000 horsepower; 56, of between 2,000 and 5,000 horsepower; 78, of between 1,000 and 2,000 horsepower; 121, of between 500 and 1,000 horsepower; 445, of between 200 and 500 horsepower; and 1,026, of less than 200 horsepower. On the other hand, as shown by Table 21, the composite stations included but 14 stations with a dynamo capacity of 5,000 horsepower and upward; 25, of between 2,000 and 5,000 horsepower; 48, of between 1,000 and 2,000 horsepower; 80, of between 500 and 1,000 horsepower; 255, of between 200 and 500 horsepower; and 624, of less than 200 horsepower.

Tables 22 and 23 present a classification of municipal stations, both purely electric and composite, on the basis of the horsepower capacity of their dynamos.

TABLE 22.—INCOME AND EXPENSES—PURELY ELECTRIC MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.	2,000 but under 5,000.	5,000 and over.
Number of stations	380	269	78	22	8	2	1
Cost of construction and equipment	$13,571,391	$3,989,635	$3,092,468	$2,200,337	$1,769,367	$1,103,232	$1,416,352
Gross income [1]	$4,147,669	$1,340,157	$925,393	$595,141	$554,156	$228,389	$504,433
Income from sale of current [1]	$4,076,439	$1,315,548	$908,767	$578,900	$553,938	$214,853	$504,433
Arc lighting	$2,276,193	$539,058	$502,879	$223,020	$321,014	$186,289	$503,933
Incandescent lighting	$1,732,235	$759,744	$394,439	$324,674	$224,450	$28,428	$500
All other electric service	$68,011	$16,746	$11,449	$31,206	$8,474	$136	.....
Income from all other sources	$71,230	$24,609	$16,626	$16,241	$218	$13,536	.....
Total expenses	$3,021,025	$1,085,266	$743,571	$483,766	$311,128	$149,190	$248,104
Salaries and wages	$1,114,577	$388,118	$274,164	$155,305	$129,557	$71,164	$96,269
Cost of supplies and materials	$464,938	$168,282	$114,211	$80,763	$44,878	$18,283	$38,521
Cost of fuel	$781,558	$305,611	$188,485	$86,100	$93,920	$28,453	$78,989
Rent of power	$104,796	$31,839	$23,823	$49,134	.....	.....	.....
Rents, taxes, insurance, and miscellaneous	$281,197	$86,693	$67,945	$55,921	$31,023	$5,290	$34,325
Interest on bonds	$273,959	$104,723	$74,943	$56,543	$11,750	$26,000	.....
Salaried officials and clerks:							
Number	456	235	118	60	24	13	6
Salaries	$246,280	$107,113	$65,609	$37,396	$19,806	$12,106	$4,250
Wage-earners:							
Average number	1,412	526	340	177	167	96	106
Wages	$868,297	$281,005	$208,555	$117,909	$109,751	$59,058	$92,019

[1] Includes estimated income from public lighting.

TABLE 23.—INCOME AND EXPENSES—COMPOSITE MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.	2,000 but under 5,000.	5,000 and over.
Number of stations	435	343	86	3	3	.....	.....
Cost of construction and equipment	$8,449,082	$4,816,612	$3,122,060	$288,913	$221,497	.....	.....
Gross income [1]	$2,817,436	$1,679,501	$959,479	$77,154	$101,302	.....	.....
Income from sale of current [1]	$2,760,417	$1,652,068	$930,950	$77,154	$100,245	.....	.....
Arc lighting	$1,113,052	$639,914	$399,631	$46,286	$27,221	.....	.....
Incandescent lighting	$1,627,383	$1,004,832	$524,449	$30,568	$67,534	.....	.....
All other electric service	$19,982	$7,322	$6,870	$300	$5,490	.....	.....
Income from all other sources	$57,019	$27,433	$28,529	.....	$1,057	.....	.....
Total expenses	$2,224,962	$1,345,138	$743,060	$44,875	$91,889	.....	.....
Salaries and wages	$765,145	$459,848	$257,010	$18,828	$29,459	.....	.....
Cost of supplies and materials	$387,963	$218,057	$138,984	$7,923	$22,999	.....	.....
Cost of fuel	$664,266	$421,832	$215,326	$10,411	$16,697	.....	.....
Rent of power	$18,770	$10,270	$8,500	.....	.....	.....	.....
Rents, taxes, insurance, and miscellaneous	$157,972	$93,355	$50,592	$4,338	$9,687	.....	.....
Interest on bonds	$230,846	$141,776	$72,648	$3,375	$13,047	.....	.....
Salaried officials and clerks:							
Number	494	358	126	3	7	.....	.....
Salaries	$211,101	$134,993	$70,032	$1,100	$4,976	.....	.....
Wage-earners:							
Average number	1,055	665	328	28	34	.....	.....
Wages	$554,044	$324,855	$186,978	$17,728	$24,483	.....	.....

[1] Includes estimated income from public lighting.

These figures do not call for extensive comment, but it might be pointed out that only 6 of the composite stations had dynamos with a capacity of 500 or more horsepower and 343 out of 435 had less than 200 horsepower. Both the cost of construction and equipment and the size of the plant were greater for the purely electric class. It is observed that the 11 stations with a dynamo capacity of 1,000 horsepower or more represented a much heavier cost of construction than all of the 269 under 200 horsepower. The 11 stations involved an outlay of $4,288,951, while the 269 were reported as having expended $3,989,635. It may be noted, on the other hand, that the earnings from the sale of current of the 269 stations with the smaller cost of equipment were $1,315,548, while the earnings from the sale of current of the 11 large stations with the larger cost were only $1,273,224.

As in the case of private stations, the assumption that there is a saving of expenses as a result of the operation of various enterprises from one station is hardly substantiated by the statistics. The strictly electric municipal stations reported earnings of $4,076,439 from the sale of current, at a cost of $886,354 for fuel and power. The composite stations reported earnings of $2,760,417 from the sale of current, requiring an expenditure of $683,036 for fuel and rented power. The lesser magnitude of the private stations operated in connection with other business would prevent them from showing up well in comparison with the larger purely electric stations. Moreover, it may be assumed that in many instances, in spite of surface indications, there is a real economy or benefit resulting from the combination of various businesses in this manner, and that without such a division of executive and physical expenses the advantages of electric light and power would probably be beyond the reach of many of the smaller communities.

IV.

INCOME.

General analysis of income.—In the section immediately preceding, reference has been made to the general statistics of income in private and municipal central stations, and the totals were summarized in Tables 12 and 13. As is well known, the two main departments of business in the industry are arc lighting and incandescent lighting. The receipts from both of these are clearly set forth in the returns, and the remainder of the income is grouped into two other classes, namely, "all other electric service," and "all other sources." By far the most important item of the income from "all other electric service" is that derived from the sale of current for the operation of stationary and railway motors. Where current is sold by meter, however, it is practically impossible to state the exact amount received from this branch of the service, while it is not at all improbable that a distinct percentage of the income returned as from incandescent lighting might be attributed to motor earnings. The motors are to-day almost invariably operated on the incandescent circuits, and a central station, without a very close census of its customers, is not able to tell to what extent its circuits are drawn upon for motors unless the motors have been installed under some special arrangement or take current in notably large quantities. A consideration of this question will be given more in detail in connection with the closer analysis of the income arrived at in other tables.

As shown in Tables 12 and 13, of the $85,700,605 received as income, arc lighting supplied $25,481,045; incandescent lighting, $44,657,102; all other electric service, $14,048,458; and all other sources, $1,514,000. These four classes formed the following proportions of the total: Arc lighting, 29.7 per cent; incandescent lighting, 52.1 per cent; all other electric service, 16.4 per cent; and all other sources, 1.8 per cent. The income is almost entirely derived from the sale of current to be converted either into illumination or into motive power.

Income of private stations, by states.—The gross income of the private stations, as shown in Table 68, was $78,735,500, of which $77,349,749 was from sale of current and $1,385,751 from all other sources. The earnings from the sale of current were divided as follows: Arc lighting, $22,091,800; incandescent lighting, $41,297,484; and all other electric service, $13,960,465. By far the largest earnings were reported from the state of New York, where the gross income was $16,631,802, of which all but $112,313 was derived from the sale of current. The next largest earnings were those of Pennsylvania, for which state the gross income was $9,057,503, of which all but $172,440 was derived from the sale of current. Third in order was Massachusetts, with a gross income of $6,070,643, of which all but $90,683 resulted from the sale of current. Fourth in magnitude was Illinois, with $5,578,012, of which all but $63,443 was from the sale of current. Closely following Illinois was California, with the large income of $4,937,444, of which all but $113,405 was from the sale of current.

For the 5 states named above the reports showed a gross income of $42,275,404, or nearly one-half of the total for the country. For the next most important group of 5 states, namely, Ohio, New Jersey, Missouri, Texas, and Michigan, the reports showed a gross income of $13,042,876. Thus for these 10 states the gross income amounted to $55,318,280, or about 70.2 per cent of the total for all private stations. A large amount of income was not reported for any of the Southern states except Missouri and Texas. The gross income for Missouri was brought up by the heavy earnings of St. Louis, while Texas, with $1,957,568, is a magnificent exception to the low average of the South-

ern states. The most noteworthy instance of income from central station operation is found in the state of Montana, which, with a population of 243,329, had an income of more than a million dollars. When this income is compared with those of the more populous states, the high ratio for this state is surprising.

The figures in Table 68 should not, however, be taken as representing the absolute total for each state in the field of electric lighting, as in many instances central stations were operated in conjunction with electric railway systems. There were 253 electric railway companies that reported income from the sale of current for electric lighting and power purposes. Of these, 118 made supplementary reports, which showed receipts of $6,469,726 from the lighting and power part of the business. It is obvious that the distribution of this amount among the central stations in the various states would be likely in several of them to increase quite noticeably the income derived from the electric lighting and power industry. In this connection attention is again called to Table 97, which shows the income of these stations by states.

Income of municipal stations, by states.—An analysis of the income of municipal stations, by states, is given in Table 78. The gross income for the United States was $6,965,105, of which all but $128,249 was derived from the sale of current. This gross income was earned by 815 stations, giving an annual income per station of $8,546 per year, as compared with an average of $28,070 for private stations. The state with the largest amount was Illinois, the sum being $1,179,003. This represents an average of $14,378 for the 82 stations, but the fact is that this average is brought up almost entirely by the large municipal system in Chicago. Illinois did not represent the highest average per station, the figures of that state being exceeded in several others. In Connecticut the 3 stations reported an income that averaged over $15,000 per station; the 17 stations in Massachusetts had an average of $15,900; the 1 station in Montana, $16,208; the 7 stations in Texas, nearly $17,000; the 7 stations in Washington, over $21,000; and the 5 stations in Florida, over $26,000. On the other hand, the states in which the income per station fell below the average for the United States were numerous. In Colorado the 2 municipal stations reported an average of only $2,763 per station; the single station in Utah, only $2,870; the single station in New Hampshire, $3,250; the 6 stations in Oregon, slightly more than $3,500; the 19 stations in Tennessee, $4,436; and the 16 stations in North Carolina, less than $6,000. In Vermont 11 stations reported a gross income of $52,113, or considerably less than $5,000 per station, while the 10 in Virginia reported $55,826, or slightly more than $5,500 per station. Such figures are significantly indicative of the smallness of the communities served.

Income from lighting.—According to Tables 76 and 86, which will be discussed later, the income from the sale of current for lighting purposes was derived from 385,698 arc lamps and 18,194,044 incandescent lamps. The following statement shows the number of arc and incandescent lamps reported by private and municipal stations, as used for commercial and public service, as well as the total income from each variety of lamp with the average income per lamp:

Number of lamps in service, total income, and average income per lamp: 1902.

	ARC LAMPS.		INCANDESCENT LAMPS.	
	Commercial or other private service.	Public service.	Commercial or other private service.	Public service.
Private stations:				
Number of lamps	168,180	166,723	16,243,853	372,740
Total income	$8,220,154	$13,871,646	$39,039,557	$2,257,927
Average income per lamp	$48.88	$83.20	$2.40	$6.06
Municipal stations:				
Number of lamps	5,793	45,002	1,494,531	82,920
Total income	$240,166	[1] $3,149,079	$2,868,296	[1] $491,322
Average income per lamp	$41.46	$69.98	$1.92	$5.93

[1] Value estimated according to prevailing rates.

While it must be borne in mind that in many cases the number of lamps reported was estimated, it is believed that the totals approximate sufficiently the actual numbers not to vitiate seriously the deductions arrived at from the above statement and from other tables that follow.

Of the 334,903 arc lamps reported by all stations operating under private ownership, 168,180, or 50.2 per cent, were used for commercial or other private lighting, and furnished an income of $8,220,154, or $48.88 per lamp; and 166,723, or 49.8 per cent, were used for public lighting, and furnished an income of $13,871,646, or $83.20 per lamp. Of the 50,795 lamps reported by municipal stations, 5,793 were used in commercial or other private lighting, and furnished an income of $240,166, or $41.46 per lamp; and 45,002, or 88.6 per cent, were used for public lighting, and had an estimated income of $3,149,079, or $69.98 per lamp.

As already stated, the income of municipal stations from public lighting can not be arrived at directly, as there is generally no basis, scale, or rate of charges by the community to itself, and the income from public lighting is therefore estimated for each station at the commercial rates prevailing in the vicinity or region. The number of lamps, however, is not the number actually rendering service at any one time, but only the number in position to render service and therefore to earn an income.

Of the incandescent lamps, 16,243,853 were in commercial use from private stations and earned $39,039,557, or an average income of $2.40 per lamp; and 1,494,531 were in commercial service from municipal stations

and earned $2,868,296, or $1.92 per lamp. In public service there were 372,740 incandescent lamps from private stations and these lamps earned $2,257,927, or an average income of $6.06 per lamp; and 82,920 were in public service from municipal stations and earned $491,322, or an average per lamp of $5.93. Incidentally it may be pointed out that the incandescent lamps in private service were usually of 16 candlepower, while those in public service were often of 32 and 50 candlepower, and were burned more continuously.

Basis of income from arc lamps.—While the average earnings of the arc lamps were $66.06, the amount per lamp ran through a wide range. Although round figures are very often quoted in comparing the rates in one city with those in another, regardless of the underlying conditions, the prices actually paid for arc lamps vary with almost every station. The price of supplying an arc lamp is determined by a number of conditions, such as the variation in the cost of waterpower and steampower, the use of overhead wires or underground circuits, the employment of large arcs requiring 550 watts at the lamp terminals or smaller arcs requiring only 340 or 350 watts, the use of open or inclosed lamps, the local prices of labor, the cost of land, and the rate of taxes. Aside from these variable elements are those attaching to the length of term of contract made. An electric lighting company invariably makes a considerable reduction when enabled by a long contract to invest safely in the necessary machinery.

As a matter of fact the companies are very often under pressure or inducements that result in rates below a profitable point, and will quote low figures to secure a franchise and even lower ones to keep a competitor out, or to prevent the installation of a municipal system. Superficially, the public benefits, but it may be questioned whether rates thus unduly depressed can make for good and efficient service.

Another fluctuating element is the number of hours of burning. In 1902 there were in the United States some seven main schedules with regard to the time of burning, and in the schedules there was a possible range of at least one hundred and fifty changes. These schedules comprised, for example, various forms of midnight moonlight schedules, ranging ordinarily from 1,220 to 1,387 hours per year, with actual variations from 1,053 to 1,485 hours. There are also a standard 1 a. m. moonlight schedule, a 2 a. m. moonlight schedule, a midnight every night schedule, a 12.30 a. m. every night schedule, a 1 a. m. every night schedule, a moonlight and cloudy night schedule, a 3 a. m. every night schedule, a standard Philadelphia schedule of 10 hours nightly, and a standard all night every night schedule of 4,000 hours.

The rate in the borough of Manhattan for all night lights with underground circuits, but only on a year-to-year contract, was $146 a year. In Boston, where the arc lighting contract is on a basis of five-year periods, the price was $124.10. In Philadelphia, where the contract embraced nearly 10,000 lights, as compared with less than 3,000 in New York, the price was $110.12. In Providence the rate was $118.62; in Cleveland, with overhead circuits, it fell to $77.88; in San Francisco it was $110. Practically all of these rates were on the all night every night basis for full arc lamps.

At Athens, Ga., the price per lamp was as low as $43.50, but this was only for 2,900 hours of burning, with all overhead circuits. At Canton, Ill., it was $48, but the lamps were what is known as "half arcs," and the period of burning was only 2,255 hours. At Elmwood, Ill., the rate was $48 for full arcs, but the period of burning was only 1,410 hours. At South Bend, Ind., full arcs burned for 1,825 hours were paid for at the rate of $62.50, but those burned for 4,000 hours cost $90. At Rockland, Me., on the other hand, the price for half arcs burned only 2,816 hours was $100 a year, while at Muscatine, Iowa, the rate for full arcs burned 4,000 hours rose to $132. It should not be overlooked, however, that at Rockland the price of steam coal was $5.52 per ton, although the high rate at Muscatine can not be accounted for in the same manner. At Haverhill, Mass., a city of less than 40,000 inhabitants, the rates were also high, being $112 a year for lamps burned 3,122 hours, and $125 for lamps burned 3,768 hours.

While similar figures could be quoted from many schedules of other towns and cities, those already given will serve to illustrate the difficulty connected with the enumeration of arc lighting prices and with the determination as to how far they correspond in the matter of amount of service rendered. Superficially, the candlepower hours furnished for 1 cent ranged from about 300 up to 1,300, and in some cases even to 1,600; but special conditions would be found to affect the extreme cases and to explain the figures of marked cheapness or unusual dearness.

For fuller information on this subject the reader is referred to the statistics published yearly by the National Electric Light Association, embodying the conditions of municipal lighting contracts. The association publishes also rates for lighting and power service in commercial business, and here, again, endless variety exists, the prices paid being subject to rebates and conditions which make it almost impossible to determine how much each lamp has earned during the year. The charges for commercial arcs are usually on a basis of service from sunset until 9 o'clock, 10 o'clock, 11 o'clock, or midnight, with longer burning frequently for Saturday nights, and no burning for Sundays. The price for such service ranges from $1.25 to $2.25 per week. Sometimes, however, the current is sold on a monthly basis, say $6 or $7.50 per month, and in other instances it is sold at some such rate as 10 cents per hour for the

first 30 hours of maximum demand and 5 cents for all excess consumption, with a minimum charge of $2 a month per lamp. In still other instances, the rate is $5 per month in summer and $9 per month in winter on a midnight schedule. In almost every town and city each company has its own basis of charge and discount, a rebate being allowed for hours when the lamps are actually interrupted, and the discounts ranging from 10 to 20 per cent, according to the amount of the bills. Hence, even when the number of watt hours furnished to the lamps for 1 cent is figured out, a fair and safe comparison can not be reached until all the other elements are taken into consideration. Thus, while the figures cited here with regard to the average income of arc lamps are of interest, they should be regarded only as average, as the actual prices paid for street lighting would be found on examination to go far above the average of $83.20 per lamp quoted above, so far as the largest cities of the country are concerned, and to fall considerably below it in many of the smaller communities.

Basis of income from incandescent lamps.—The incandescent lamps also are subject to an infinite variety of rates, almost every city and town having its own scale of prices, some on a meter basis and some on a flat rate basis. It is quite customary to assume for rough and ready purposes of calculation an earning capacity of 1 cent per hour per incandescent lamp; but this, while a very fair approximation to the facts of the case, is subject to infinite variations. Where flat rates are applied, it is not at all unusual to find 16-candlepower lamps rated at a charge of 50 cents per month for use until 9 or 10 o'clock p. m. and 75 cents a month for all night use. In many instances current for such lamps when metered is sold at a rate of from 10 cents to 15 or 20 cents per kilowatt hour, and is subject to discounts which run as high as 50 per cent after a monthly consumption of 30 hours has been reached. Thus in Boston a demand system has been in use based upon 1 cent per 16-candlepower lamp per hour for the first 400 hours of use. When the use exceeds 400 hours a rebate of 40 per cent is given. Other demand systems have also been in use, in which the underlying aim has been to encourage large consumption or to make it inviting for a small consumer to use his maximum capacity by scaling down the prices after a lower limit has been reached, the fixed minimum being one that will to some extent recoup the lighting company for its fixed charges and its stand-by investment; that is, for the equipment which it must have ready in order to give service, so that it is competent to deal with any demand that may come upon the system. In many places residence lighting is fostered with discounts on a sliding scale from 20 per cent on bills under $2.50 per month up to 50 per cent on bills over $75 per month. A great many stations have also adopted a practice of making free lamp renewals; that is, they remove the old incandescent lamps and replace them with new ones upon the request of the consumer. In some cities a different rate is given in summer from that in winter. In Denver an interesting system has been in use for some time which assumes a fixed charge per customer to begin with. Thus the scale for incandescent lighting there has been $12 per year per consumer, plus $1.80 per year per lamp connected, plus 5 cents per kilowatt hour for current used. This is subject to a 10 per cent discount for prompt payment of monthly bills, and can be varied by a rate of 10 cents per kilowatt hour for metered current, with a minimum rental of $1.50 per month and at least 5 cents per lamp connected.

Income per lamp of stations, classified according to dynamo capacity.—In Tables 24 to 27 the gross figures of income from arc and incandescent lighting, the number of lamps, and the income per lamp are shown for stations classified according to the horsepower capacity of dynamos. Tables 24 and 25 present the statistics for purely electric and composite private stations, while Tables 26 and 27 show similar statistics for purely electric and composite municipal stations. In discussing these tables, attention is again called to the fact that in some cases the number of lamps was estimated, and, further, that in some instances income that properly belonged to motor service was credited to lighting.

The following table gives the statistics for the purely electric private stations:

TABLE 24.—INCOME PER LAMP—PURELY ELECTRIC PRIVATE STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

HORSEPOWER CAPACITY OF DYNAMOS.	ARC LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.
Total	$14,721,531	219,409	$67.10	$5,365,793	107,743	$49.80	$9,355,738	111,666	$83.78
Under 200	1,036,360	16,660	62.21	248,062	4,664	53.19	788,298	11,996	65.71
200 but under 500	1,371,498	22,096	62.07	400,941	8,044	49.84	970,557	14,052	69.07
500 but under 1,000	988,447	16,146	61.22	301,796	6,845	44.09	686,651	9,301	73.83
1,000 but under 2,000	1,563,861	26,480	59.06	638,111	13,599	46.92	925,750	12,881	71.87
2,000 but under 5,000	2,507,585	39,048	64.22	861,046	19,821	43.44	1,646,539	19,227	85.64
5,000 and over	7,253,780	98,979	73.29	2,915,837	54,770	53.24	4,337,943	44,209	98.12

TABLE 24.—INCOME PER LAMP—PURELY ELECTRIC PRIVATE STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902—Continued.

HORSEPOWER CAPACITY OF DYNAMOS.	INCANDESCENT LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.
Total	$28,082,469	11,463,050	$2.45	$26,591,126	11,195,351	$2.38	$1,491,343	267,699	$5.57
Under 200	3,711,212	1,259,022	2.95	3,304,222	1,212,655	2.72	406,990	46,367	8.78
200 but under 500	3,688,358	1,492,466	2.47	3,349,070	1,451,744	2.31	339,288	40,722	8.33
500 but under 1,000	1,988,136	801,130	2.48	1,827,663	779,914	2.34	160,473	21,216	7.56
1,000 but under 2,000	2,378,876	1,001,977	2.37	2,229,011	985,077	2.26	149,865	16,900	8.87
2,000 but under 5,000	3,617,887	1,300,056	2.78	3,525,092	1,282,659	2.75	92,795	17,396	5.33
5,000 and over	12,698,000	5,608,400	2.26	12,356,068	5,483,302	2.25	341,932	125,098	2.73

The number of arc lamps for which power was generated in the purely electric private stations was 219,409, and the earnings were $14,721,531, or $67.10 per lamp. Of the lamps, 107,743 were commercial or other private types, earning $5,365,793, or $49.80 per lamp, and 111,666 were public lamps, with an income of $9,355,738, or $83.78 per lamp.

The income per lamp does not appear to have been in proportion to the size of the plant, but was subject to many variations. The income per lamp in the commercial field, for example, was high in the two extreme classes, and in them was almost identical, being $53.19 for lamps operated from stations of less than 200 horsepower and $53.24 for lamps from stations of 5,000 horsepower and over. On the other hand, the revenue derived from public lighting was lowest in the class of stations of less than 200 horsepower and highest in the two groups with the larger plants. Thus for the smallest stations it was only $55.71 per lamp, while for the group with a horsepower capacity between 2,000 and 5,000 and that with a capacity of 5,000 or more it reached $85.64 and $98.12, respectively. The reason for this would appear to be that in the smaller stations the circuits are largely overhead, and, with other expenses on a lower plane, lamps and currents can be supplied at a cheaper rate, whereas the larger stations, as a rule, operate with underground circuits and are under heavier expense for rent, wages, etc. Moreover, the small stations showed a rather high return from commercial arc lighting as compared with almost all of the larger stations because very often the small plant is equipped for an arc lighting service only, and the customers have to take that or none at all, while in systems where the incandescent lamp is available it is preferred, since it is more suitable for many classes of service, and its use in corresponding degree lessens the returns from arc lighting. It is worthy of note that in purely electric stations of between 2,000 and 5,000 horsepower the income derived from commercial arc lamps was only $43.44 per lamp, or barely over half that derived from the longer burning public lamps, namely, $85.64, a ratio which is apparent also in the incandescent lighting.

In purely electric private stations, there were 11,195,351 incandescent lamps in commercial or other private service, with earnings of $26,591,126, or $2.38 per lamp; and 267,699 public incandescent lamps, with earnings of $1,491,343, or $5.57 per lamp. The reasons for this difference between commercial and public incandescent lighting have already been stated. The classification on the basis of capacity of plants brings out quite clearly the general tendency of the smaller plants to charge higher rates for incandescent service, the standard being 1 cent per 16-candlepower hour, while with the larger plants and the heavier production of current on a meter basis, lower rates are rendered more and more feasible. It will be seen that for stations of less than 200 horsepower, with a little over 10 per cent of the commercial lamps, the income per lamp was $2.72, which was higher than that for any class except that between 2,000 and 5,000 horsepower, in which the earnings were 3 cents more per lamp. The lamps operated from stations of 5,000 horsepower capacity and upward numbered 5,483,302, or not quite 50 per cent of the total, and the average yield for them was the lowest in the scale, being $2.25 per lamp.

In regard to incandescent public lighting the variations are apparently quite radical, but can be satisfactorily accounted for. In stations of less than 200 horsepower the income per public lamp was $8.78, this being exceeded only by that for lamps in stations of from 1,000 to 2,000 horsepower, where earnings were $8.87 per lamp. In the two classes comprising stations of the largest dynamo capacity the income per public lamp fell below the averages for the other classes; in the largest stations it was only $2.73 per lamp, or little more than the earnings per commercial lamp, namely, $2.25. As a matter of fact, in the large cities incandescent lamps, whether large or small, are seldom used for public or street lighting, so that the ordinary 16-candlepower lamps employed for public purposes would be likely to be subject to the ordinary hours of burning, except in such places as police stations, hospitals, and fire engine houses, where the average would be raised somewhat. In smaller communities, however, it is not an unusual thing to see street lighting attempted with

incandescent lamps, and these are usually supplied on a yearly contract basis which provides for several hours of burning nightly. Consequently in the case of ordinary 16-candlepower lamps the yield per lamp would be very far above the average. Moreover, it is customary to employ for part of such work lamps of higher candlepower. These conditions brought out by this table explain the facts.

Analogous conditions are exhibited by Table 25, which deals with composite private stations.

TABLE 25.—INCOME PER LAMP—COMPOSITE PRIVATE STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

HORSEPOWER CAPACITY OF DYNAMOS.	ARC LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.
Total	$7,370,269	115,494	$63.82	$2,854,361	60,437	$47.23	$4,515,908	55,057	$82.02
Under 200	672,777	10,429	64.51	152,259	2,930	51.97	520,518	7,499	69.41
200 but under 500	1,163,709	17,261	67.42	351,770	6,183	56.89	811,939	11,078	73.29
500 but under 1,000	850,469	13,361	63.65	296,528	6,421	46.03	554,941	6,940	79.96
1,000 but under 2,000	1,158,251	16,768	69.08	414,098	7,791	53.15	744,153	8,977	82.90
2,000 but under 5,000	848,667	13,504	62.85	324,382	7,218	44.94	524,285	6,286	83.41
5,000 and over	2,676,396	44,171	60.59	1,316,324	29,894	44.03	1,360,072	14,277	95.26

HORSEPOWER CAPACITY OF DYNAMOS.	INCANDESCENT LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.
Total	$13,215,015	5,153,543	$2.56	$12,448,431	5,048,502	$2.47	$766,584	105,041	$7.30
Under 200	2,105,263	675,234	3.12	1,908,256	655,014	2.91	197,007	20,220	9.74
200 but under 500	2,345,172	833,543	2.81	2,201,970	816,372	2.70	143,202	17,171	8.34
500 but under 1,000	1,397,354	556,876	2.51	1,321,753	548,377	2.41	75,601	8,499	8.90
1,000 but under 2,000	1,670,560	664,026	2.52	1,555,464	646,024	2.41	115,096	18,002	6.39
2,000 but under 5,000	1,305,166	588,215	2.22	1,201,569	574,636	2.09	103,597	13,579	7.63
5,000 and over	4,391,500	1,835,649	2.39	4,259,419	1,808,079	2.36	132,081	27,570	4.79

These stations had an average income of $63.82 per arc lamp. The average for commercial arc lamps was $47.23, while that for public lamps was $82.02. The classification by dynamo capacity shows that in commercial lighting the lamps in the smaller composite stations were paid for at a higher rate than those in the large stations, the income per lamp being $51.97 in stations of less than 200 horsepower, and $56.89 in stations of between 200 and 500 horsepower, while it was $44.94 in stations of 2,000 to 5,000 horsepower, and $44.03 in stations of 5,000 horsepower and upward. The composite stations had also somewhat the advantage as to public lighting, for, with an assumable economy in the production of current, the income per lamp was $82.02 as compared with $83.78 for purely electric stations. Where the plants were small, the composite stations were able to secure very good returns from public lighting. Composite stations of less than 200 horsepower had an income of $69.41 per lamp, as compared with $65.71 in the purely electric class; and composite plants of between 200 and 500 horsepower had an income of $73.29 per lamp, as compared with $69.07 in stations of the purely electric class.

The incandescent lighting business of composite stations was done with 5,153,543 incandescent lamps earning $13,215,015, or $2.56 per lamp. There were 5,048,502 lamps in commercial use earning $12,448,431, or $2.47 per lamp, and 105,041 public lamps earning $766,584, or $7.30 per lamp. It is certainly remarkable that the earnings of composite stations should be higher in both classes of service than the earnings of purely electric stations. The commercial incandescent business of the purely electric private plants brought in only $2.38 per lamp as compared with the $2.47 now noted, and the public lamps brought in only $5.57 as compared with $7.30. The classification shows that the benefit of the higher income was enjoyed largely by the group of stations of less than 200 horsepower, for which the income averaged $2.91 for commercial lamps and $9.74 for public lamps. The income from the commercial lamps on the circuits of the largest composite stations was slightly above that for the purely electric group, being $2.36 and $2.25, respectively, while the income from public lamps was decidedly higher in composite stations, being $4.79 in comparison with $2.73 for the purely electric stations. These variations are probably symptomatic, although they are due, in part, to the operation of certain specific stations where business had been developed largely along a given line on account of the desire of managers for a certain class of customers. While some central station managers are averse to public incandescent lighting business, others are willing

and glad to supply power for such purpose, and the same idiosyncrasies are seen in other departments of exploitation in the industry. A broad inference from Tables 24 and 25 is that, with the assumable economy in current production and the higher returns per arc and incandescent lamp, the composite stations should be on a more profitable basis than the purely electric ones. From this point of view the contention for consolidation of diverse businesses under one management, or within the one plant, is justified.

Tables 26 and 27 classify the income per lamp for the two groups of municipal stations according to the horsepower capacity of dynamos.

TABLE 26.—INCOME PER LAMP—PURELY ELECTRIC MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

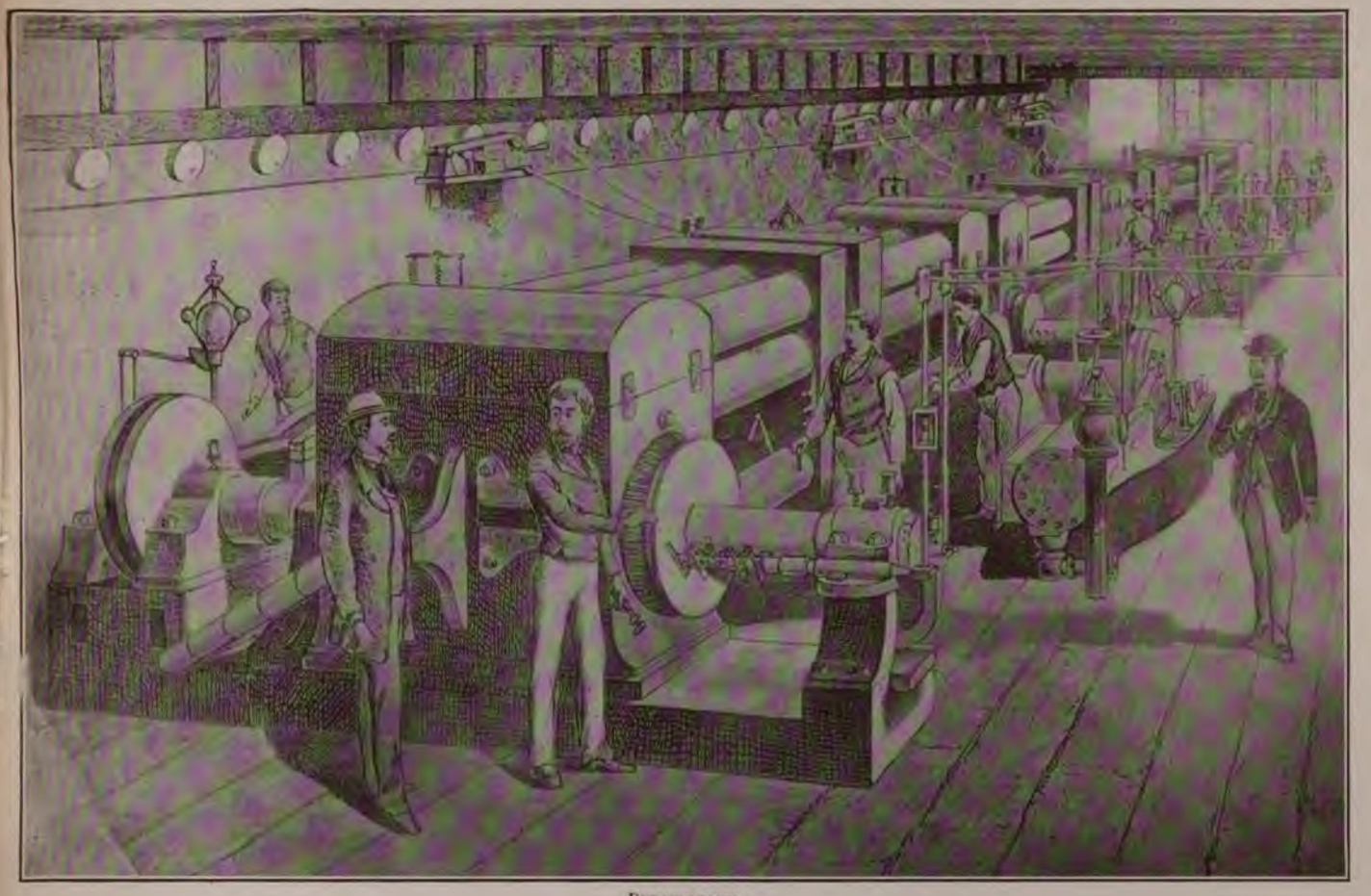
HORSEPOWER CAPACITY OF DYNAMOS.	ARC LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.[1]	Number of lamps.	Income per lamp.
Total	$2,276,193	32,998	$68.98	$151,390	3,682	$41.12	$2,124,803	29,316	$72.48
Under 200	589,058	8,809	61.19	37,168	773	48.08	501,890	8,036	62.46
200 but under 500	502,879	8,276	60.76	42,143	996	42.31	460,736	7,280	63.29
500 but under 1,000	223,020	4,077	54.70	42,525	1,330	31.97	180,495	2,747	65.71
1,000 but under 2,000	321,014	4,545	70.63	29,554	583	50.69	291,460	3,962	73.56
2,000 but under 5,000	186,289	2,829	65.85	.....	.....	.....	186,289	2,829	65.85
5,000 and over	503,933	4,462	112.94	.....	.....	.....	503,933	4,462	112.94

HORSEPOWER CAPACITY OF DYNAMOS.	INCANDESCENT LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.[1]	Number of lamps.	Income per lamp.
Total	$1,732,235	785,868	$2.20	$1,423,538	732,929	$1.94	$308,697	52,939	$5.83
Under 200	759,744	298,697	2.54	641,433	285,397	2.25	118,311	13,300	8.90
200 but under 500	394,439	226,991	1.74	344,372	216,945	1.59	50,067	10,046	4.98
500 but under 1,000	324,674	163,725	1.98	292,431	157,038	1.86	32,243	6,687	4.82
1,000 but under 2,000	224,450	84,065	2.67	144,604	73,125	1.98	79,846	10,940	7.30
2,000 but under 5,000	28,428	12,190	2.33	698	424	1.65	27,730	11,766	2.36
5,000 and over	500	200	2.50	.....	.....	.....	500	200	2.50

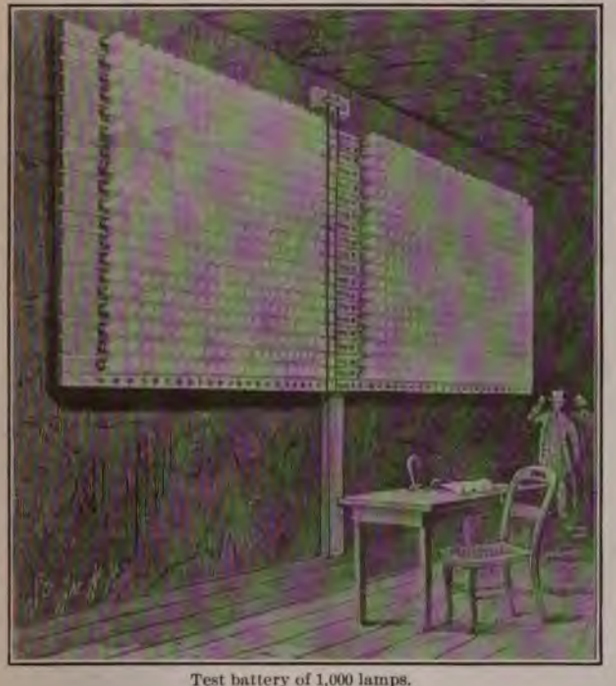
[1] Estimated according to prevailing rates.

The purely electric stations, with 32,998 arc lamps, had an income per lamp of $68.98. The income per commercial arc lamp was $41.12, while that of the public arc lamp was $72.48. For commercial lamps the rates of income did not differ greatly from those obtained by private plants, although in one class the rate was much lower. The income per commercial lamp for stations under 200-horsepower capacity was $48.08, but in the class between 500 and 1,000 horsepower it was only $31.97. In the next group, however, between 1,000 and 2,000 horsepower, it was $50.69, which was considerably higher than the figure for the corresponding private stations, which reported an income of only $46.92 per commercial arc lamp. The figures for the public arc lamps are higher than might be expected, but, as already stated, they have, in many instances, been estimated on the basis of private service in the same region. While this is a reasonable method of securing comparative data, it seems to operate to the disadvantage of the municipal stations. In other words, while the gross income derived by the municipal stations is increased on this basis and to that extent makes a better showing, it necessarily involves a higher ratio of income per lamp, which, in other words, means a higher charge or cost to the community for the service rendered.

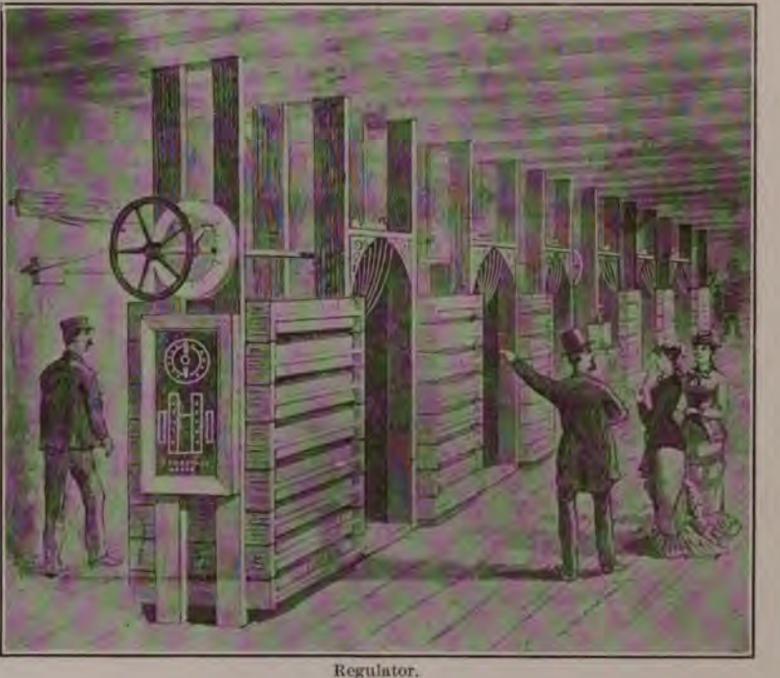
The figures for incandescent lighting show that the rate of income per lamp is lower in municipal stations than in private stations, this fact indicating superficially less effort to push this class of business in the municipal stations. For the purely electric municipal stations the average income per lamp was $2.20, while in the group of composite municipal stations it was $2.06 per lamp; similar averages for the two groups of private stations were $2.45 and $2.56. The income per commercial incandescent lamp of the purely electric municipal stations was $1.94—a still further indication, when taken with the return of $1.90 for the composite stations, of the small income derived from this class of service. The public lamps of these stations earned an average of $5.83 per lamp, although in the composite stations the average was $6.09. The variations in the purely electric municipal stations as to commercial and public incandescent lamps follow the same lines as those already considered in discussing the similar statistics for the private stations. The composite municipal stations, however, show some rather striking variations in Table 27.



Dynamo room.



Test battery of 1,000 lamps.



Regulator.

FIRST EDISON STATION IN NEW YORK CITY, PEARL STREET.

These views of the first Edison station in New York city show the first American dynamos direct connected to steam engines; also primitive regulating apparatus and testing group of a thousand lamps.

TABLE 28.—INCOME PER LAMP—PURELY ELECTRIC PRIVATE STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902—Continued.

POPULATION OF PLACES IN WHICH LOCATED.	INCANDESCENT LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.
Total	$28,082,469	11,463,050	$2.45	$26,591,126	11,195,351	$2.38	$1,491,343	267,699	$5.57
Under 5,000	6,512,620	2,383,717	2.73	5,840,182	2,306,796	2.53	672,438	76,921	8.74
5,000 but under 25,000	3,562,386	1,458,719	2.44	3,299,706	1,420,795	2.32	262,680	37,924	6.93
25,000 but under 100,000	4,018,412	1,426,314	2.81	3,824,470	1,407,699	2.72	188,942	18,615	10.15
100,000 but under 500,000	5,055,736	2,357,842	2.14	4,951,942	2,341,412	2.11	103,794	16,430	6.32
500,000 and over	8,938,315	3,836,458	2.33	8,674,826	3,718,649	2.33	263,489	117,809	2.24

Purely electric private stations in cities of less than 5,000 inhabitants, as shown by Table 28, derived an income of $53.80 per lamp from commercial arc lighting, and $65.56 per lamp from public lighting. The prevalence of higher rates for commercial lighting in small places is shown by the figures for the next three smaller classes, although not in strict sequence as to size. The income per commercial lamp of stations in communities of between 5,000 and 25,000 inhabitants was $46.63, while in places of between 25,000 and 100,000 inhabitants it was $43.04, and in the places with a population of between 100,000 and 500,000 it fell to $42.72.

The highest return per commercial arc, $58.82, was obtained in cities of 500,000 inhabitants and over. This is also true of public arcs, the income being $111.97 per public arc. But while the income per commercial arc declined steadily in the various groups up to that for places with 500,000 inhabitants, it rose steadily throughout the whole scale as regards the income per public arc lamp. Some of the reasons for this have already been discussed and explained, and an additional reason is that as cities grow in size the obvious tendency and desire is to secure a better illumination of streets, and consequently the arc lamps are not burned on various limited, arbitrary or moonlight schedules, but are in service practically throughout the night the year around. Thus in the five different classes of places the income per public arc ran upward as follows: $65.56, $71.66, $77.12, $83.44, and, as already noted, $111.97.

The income per commercial incandescent lamp showed a very steady average for the various population groups; thus the income per lamp in communities of less than 5,000 inhabitants was $2.53, or slightly more than the average for all the groups, namely, $2.38. The income per lamp was $2.32 in communities of between 5,000 and 25,000 inhabitants, $2.72 in communities of between 25,000 and 100,000, $2.11 in communities of between 100,000 and 500,000, and $2.33 in cities of 500,000 and over. The public lighting with incandescent lamps showed much wider and sharper variations. It will be noted that while the average for all classes was $5.57 per lamp, it was $10.15 in communities of between 25,000 and 100,000 inhabitants, where street lighting with large incandescents is most prevalent, and was only $2.24 in the largest cities, where street lighting with incandescents is practically unknown, and where the service to public buildings would be closely analogous to that furnished commercial houses and residences.

In Table 29 figures are given for private stations operated in connection with other businesses.

TABLE 29.—INCOME PER LAMP—COMPOSITE PRIVATE STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

POPULATION OF PLACES IN WHICH LOCATED.	ARC LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.
Total	$7,370,269	115,494	$63.82	$2,854,361	60,437	$47.23	$4,515,908	55,057	$82.02
Under 5,000	878,602	13,647	64.38	232,731	4,166	55.86	645,871	9,481	68.12
5,000 but under 25,000	2,393,938	35,479	67.47	762,557	14,403	52.94	1,631,381	21,076	77.40
25,000 but under 100,000	1,338,139	21,663	61.54	538,001	12,125	44.37	795,138	9,538	83.37
100,000 but under 500,000	2,113,129	29,885	70.71	882,267	17,089	51.63	1,230,862	12,796	96.19
500,000 and over	651,461	14,820	43.96	438,805	12,654	34.68	212,656	2,166	98.18

TABLE 29.—INCOME PER LAMP—COMPOSITE PRIVATE STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902—Continued.

POPULATION OF PLACES IN WHICH LOCATED.	INCANDESCENT LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.
Total	$13,215,015	5,153,543	$2.56	$12,448,431	5,048,502	$2.47	$766,584	105,041	$7.30
Under 5,000	3,066,862	1,035,108	2.96	2,799,312	1,008,868	2.77	267,550	26,240	10.20
5,000 but under 25,000	3,779,997	1,429,518	2.64	3,540,084	1,397,358	2.53	239,913	32,160	7.46
25,000 but under 100,000	1,941,962	750,916	2.59	1,825,121	734,597	2.48	116,841	16,319	7.16
100,000 but under 500,000	2,387,984	1,121,732	2.13	2,280,399	1,098,648	2.08	107,585	23,084	4.66
500,000 and over	2,038,210	816,269	2.50	2,003,515	809,031	2.48	34,695	7,238	4.79

Some singular variations are shown in this table: For example, the income per commercial arc lamp in cities of 500,000 inhabitants and over was only $34.68, this fact implying the use of small arcs and limited hours of burning. The figures for public lighting are more consistent, although they show a tendency for the income per lamp to run lower in the largest communities included, probably as a result of the absence of underground conduits and subway rentals in the larger places where these composite plants operate. Indeed, in the smaller communities the returns per public arc were higher where composite plants were operated than where the plants were purely electric, although this might be due to the fact that in the communities of less than 100,000 inhabitants the purely electric stations were doing part of their public service with half arcs or that the varying use of inclosed arcs affected the rates charged and the similarity of the figures.

With regard to incandescent lighting it will be noted that the averages were higher in the composite stations than in the purely electric stations, being for commercial service $2.47 as compared with $2.38, and for public service $7.30 as compared with $5.57. In cities of between 100,000 and 500,000 inhabitants the income per commercial incandescent lamp was $2.08, this being the lowest return indicated anywhere in the table, while in communities of less than 5,000 inhabitants it was $2.77, which was the highest figure attained. The highest income per public incandescent lamp, $10.20, was also reached in that group; thus a very marked resort to incandescent lamps for street lighting is indicated for those places.

In Tables 30 and 31 are given the statistics of municipal stations on the basis of classified population.

TABLE 30.—INCOME PER LAMP—PURELY ELECTRIC MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

POPULATION OF PLACES IN WHICH LOCATED.	ARC LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.[1]	Number of lamps.	Income per lamp.
Total	$2,276,193	32,998	$69.98	$151,390	3,682	$41.12	$2,124,803	29,316	$72.48
Under 5,000	509,982	8,678	58.77	58,740	1,313	44.74	451,242	7,365	61.27
5,000 but under 25,000	602,458	9,900	60.85	65,643	1,614	40.67	536,815	8,286	64.79
25,000 but under 100,000	194,674	3,967	48.83	27,007	755	35.77	167,667	3,232	51.88
100,000 but under 500,000	319,186	4,544	70.24	.....	.....	.....	319,186	4,544	70.24
500,000 and over	649,893	5,889	110.36	.....	.....	.....	649,893	5,889	110.36

POPULATION OF PLACES IN WHICH LOCATED.	INCANDESCENT LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.[1]	Number of lamps.	Income per lamp.
Total	$1,732,235	785,868	$2.20	$1,423,538	732,929	$1.94	$308,697	52,939	$5.83
Under 5,000	959,421	431,794	2.22	834,056	415,341	2.01	125,365	16,453	7.62
5,000 but under 25,000	496,659	265,676	1.87	430,275	253,519	1.70	66,384	12,157	5.46
25,000 but under 100,000	171,228	65,578	2.61	157,540	62,145	2.54	13,688	3,433	3.99
100,000 but under 500,000	99,427	21,620	4.60	1,667	1,924	0.87	97,760	19,696	4.96
500,000 and over	5,500	1,200	4.58	.....	.....	.....	5,500	1,200	4.58

[1] Estimated according to prevailing rates.

TABLE 31.—INCOME PER LAMP—COMPOSITE MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

POPULATION OF PLACES IN WHICH LOCATED.	ARC LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.[1]	Number of lamps.	Income per lamp.
Total	$1,113,052	17,797	$62.54	$88,776	2,111	$42.05	$1,024,276	15,686	$65.30
Under 5,000	657,479	10,933	60.14	64,231	1,359	47.26	593,248	9,574	61.96
5,000 but under 25,000	368,013	5,801	63.44	24,545	752	32.64	343,468	5,049	68.03
25,000 but under 100,000	66,310	813	81.56	.....	.....	.....	66,310	813	81.56
100,000 but under 500,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
500,000 and over	21,250	250	85.00	.....	.....	.....	21,250	250	85.00

POPULATION OF PLACES IN WHICH LOCATED.	INCANDESCENT LIGHTING.								
	Total.			Commercial or other private.			Public.		
	Income.	Number of lamps.	Income per lamp.	Income.	Number of lamps.	Income per lamp.	Income.[1]	Number of lamps.	Income per lamp.
Total	$1,627,388	791,583	$2.06	$1,444,758	761,602	$1.90	$182,625	29,981	$6.09
Under 5,000	1,382,849	663,152	2.09	1,234,131	639,288	1.93	148,718	23,864	6.23
5,000 but under 25,000	227,734	125,969	1.81	210,627	122,314	1.72	17,107	3,655	4.68
25,000 but under 100,000	10,800	1,262	8.56	.....	.....	.....	10,800	1,262	8.56
100,000 but under 500,000	.....	.....	.....	.....	.....	.....	.....	.....	.....
500,000 and over	6,000	1,200	5.00	.....	.....	.....	6,000	1,200	5.00

[1] Estimated according to prevailing rates.

As has already been indicated, the bulk of the business of municipal stations was done in the smaller communities, namely, those not exceeding 25,000 in population. Thus, out of 17,797 arc lamps operated by composite municipal stations, 16,734 were in places of that size or under.

The income per commercial arc fell as low as $32.64. The income per public arc, as a result of the method of estimating, can be compared with the corresponding income of private stations, although the difference is in favor of the composite station. Thus the income per public arc of composite municipal stations was on the average $65.30, while for the purely electric stations it was $72.48.

The income per commercial incandescent lamp for purely electric stations was $1.94 and for the composite stations, $1.90.

Income from sources other than lighting.—In Table 13 it has been shown that the income derived from lighting by the central stations of the country constituted 81.8 per cent of the total. In that table the remaining income is divided into two classes, one being that from "all other electric service" and the other that from "all other sources," the former constituting 16.4 per cent of the total and the latter, 1.8 per cent; thus the income from these two classes formed 18.2 per cent of the entire earnings. Details as to income are given, by states and territories, in Table 68 for the private stations and in Table 78 for the municipal stations. In these tables the income from miscellaneous electric operation is broadly divided into five main classes.

Rates for motor service.—From the fact that power circuits connected with central stations draw their supply of current in the daytime, when a large proportion of the generating machinery would otherwise stand idle, a great many central stations have felt that they could make concessions and inducements in the way of special rates for current. These lower prices have enabled them to build up a new class of customers, and as a result of the increased income caused thereby they have been able to employ their machinery and operating staff a greater number of hours of the day and at a higher level of efficiency, as well as to employ more competent men and to pay better wages. So long as a company was restricted to a few hours of lighting its resources and income were limited, but with a business maintained not merely for a few hours of darkness, but carried on almost throughout the twenty-four hours, and with a fair proportion of the apparatus always in use, a large number of the stations were put into a better condition financially, and were enabled to carry out the developments and extensions that have been so marked a feature of the electric lighting industry during the past ten years. In fact, without the help of motors there would have been comparatively little incentive to introduce the many modern features which place electric current at the command of the consumer for all purposes, day and night.

The power rates deal, moreover, with current in large volume, and for this reason are lower than those for lighting. In some instances a flat rate was still charged, as, for example, $40 a year for 1 horsepower, $30 a year per horsepower for from 2 to 5 horsepower, and special rates for larger motors. Another common rate was from $1 per month for ¼-horsepower motor to $24.50 for 24 horsepower, and $1 per horsepower per month for 25 horsepower and upward. An average kilowatt hour rate for current was about 10 cents without discounts, but the actual rates ranged upward to 15 cents and downward to 3 cents and in some places a rate was quoted as low as 2 and 2½ cents. For fan motors special rates were often reported, as, for example, $2 to $3 per month during the summer months; as a general thing, however, the fan motor consumption through a meter has been paid for at the same kilowatt hour rate as that charged for incandescent lighting. The rates for power, moreover, have been subjected to varying discounts in the same manner as lighting. In some instances a minimum has been put into the power bill, as, for instance, $5 per month. At Niagara Falls, where current has been produced on a large scale, the kilowatt hour rate was 3 cents. The flat rate per year was $35 per horsepower up to and including 10 horsepower; $30 per horsepower up to and including 25 horsepower; and for quantities above 25 horsepower, $25 per horsepower.

Income of private stations from stationary motors.—It appears from Table 68 that the supply of current for motor service by private stations is now very general throughout the country, but some striking variations were presented. Motor service constituted somewhat over 12 per cent of the gross income and of the earnings from operation. As a general rule, income from motor service was most prominent in those states having abundant waterpower, and in the larger cities, where many small motors are used, thus avoiding the considerable cost of installing a steam plant. In New York the amount derived from motor service was $2,394,655, or over 14 per cent of the gross income of the private stations of the state. In California, however, striking testimony to the unusual development of power transmission enterprises in that state is again given by the fact that of the gross income of $4,937,444, not less than $1,217,379 was derived from the sale of current for stationary motor service. This is 24.6 per cent, or almost double the average for the country. In Illinois the motor service yield was $763,496, or 13.7 per cent of the gross income for the state, while in Massachusetts it was $741,103, or 12.2 per cent. The reports for Pennsylvania showed $639,860, which large sum, however, was only 7.1 per cent of the gross income of $9,057,503. The figures from Missouri are notable, the yield from motor service being $400,129, or nearly 19 per cent of the gross income of $2,121,604. The proportion in Colorado was also high, the motor service being $343,559, or 20.9 per cent of the gross income of $1,646,979. The proportion of the income from motor service to the gross income in South Carolina is striking, although the amounts are not large, the amount reported for motor service being $169,353 out of a total of $338,219. This is more than 50 per cent of the income, and is an example of the ideal condition desired by central station managers, but seldom attained by them, namely, of securing as much business and income during the daylight hours and from power load as from lighting during the hours of darkness. The only possible explanation for South Carolina is that the lighting interests there are quite small and undeveloped, while the state possesses some of the largest power transmission plants in the country, upon whose circuits are several of the largest cotton mills, requiring current throughout the day in great volume. In similar manner Utah had $156,331 derived from motor service out of a gross income of $711,483. This amounts to nearly 22 per cent, and, as in the case of Colorado and California, the high per cent can be explained by the existence of power transmission enterprises delivering current in large bulk for several hours daily to mining plants. If the income from stationary motor service supplied by stations operated by street railways, as shown in Table 97, were considered in connection with the above totals, some of the percentages would be changed.

Income of private stations from electric railway motor service.—The income from electric railway motor service supplied by private stations was reported as $2,301,343. Work of this kind was not done so generally as the stationary motor work, and the bulk of the income was derived from 5 states, namely, New York, $389,829; Pennsylvania, $324,749; New Jersey, $297,361; Massachusetts, $226,547; and California, $181,494. In this connection it might be stated that many small railways buy their power because they find it more economical than to operate their power plants for the small amount of current needed. Even some of the larger systems buy their power, but only when they can get it at a special rate, as in Buffalo, New York.

Income of private stations from electric heating and charging automobiles.—Neither electric heating nor the charging of automobiles shows up to advantage in regard to productive capacity. As seen in Table 68, the amount of income reported for electric heating by private stations was only $39,155, while the amount for charging automobiles was even less, being $29,959. A large proportion of the amount of the income from charging automobiles, namely, $13,650, is included in a group of "all other states," but should be credited to the District of Columbia, where electric automobile work has attained large proportions relatively to the rest of the

country. New York state also represented a large amount for charging automobiles, $12,685, so that the District of Columbia and New York account for $26,335 out of the $29,959. In like manner the reported business in electric heating was limited as to bulk to two or three states, of which Minnesota stood out in an extraordinary manner, with $24,289 out of $39,155 reported. Following in order came New York with $6,087; North Dakota, $6,000; and Pennsylvania, $1,182.

Electric heating was practically nonexistent in the Southern states according to the returns, although the moderate heat derivable in small quantities from electrical apparatus would appear to offer the stations in such regions an attractive field of effort.

Income of private stations from all other electric service.—Almost the entire amount for "all other electric service," $1,750,331, was reported from three states, namely, New York, $1,008,285; Montana, $257,336; and California, $227,500; although a number of other states reported small amounts. A large part of this income was received from the sale of current in bulk, as where one station sells current to another and has no means of knowing to what use it is put. It will be readily understood that in the larger cities, and particularly in New York city, industries of wide diversification called for current, while in the case of California and Montana—particularly the latter—it may be conjectured that considerable of the income noted was derived from electric mining operations, such as in electro-metallurgy, including the deposition of copper.

Electricity is employed in a great many industries which could hardly be classified as receiving service for light or power, among which might be mentioned electroplating and electro-deposition. In fact, the sale of current for all electro-chemical purposes would appear to fall into the category of miscellaneous electric service. In the same manner, large numbers of electric signs are now in use intended rather for advertising than for illumination, and these in the aggregate would represent a large amount of business which in many instances might not be brought to account specifically. For example, one incandescent lamp sign in New York city, fed with current from central station mains, contains 1,200 lamps, the initial letter being 68 feet high and covering several stories of the building upon which it is placed. It is needless to point out that 1,200 lamps burning steadily for several hours every night make a considerable demand for current which, even if sold at a low rate, would represent a large bill at the end of the year. Hundreds of such signs, large and small, are to be seen nightly in every one of the large cities of the country.

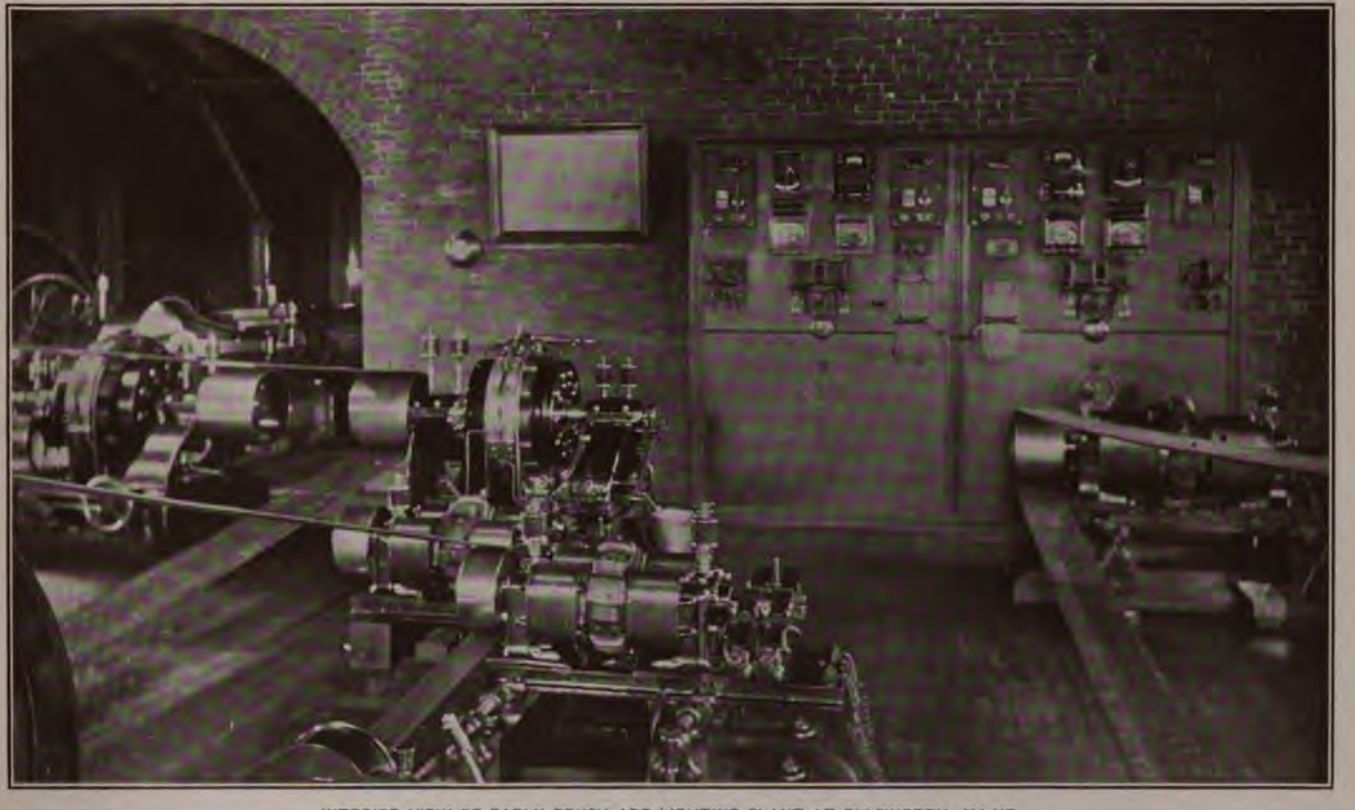
Where current is gauged by meter, central station managers are not able to ascertain definitely how much current should be charged up specifically to any branch of the service. Thus, for example, it has been more than once reported from New England that it was not until the extension of incandescent lighting circuits in certain communities or their discontinuance for repairs that the fact came to the surface that during the daytime electric heaters for cooking and other purposes were in regular use on some of them, and that people were thus seriously inconvenienced by the temporary discontinuance of the supply of current. In such cases it is obvious that the income from the sale of current for electric heating could not be calculated.

Income of private stations from all other sources.—Income from "all other sources" amounted to $1,385,751 and includes income derived from sale of electric supplies; wiring of houses; steam heating; hot water heating; rent of poles, meters, and motors; pumping; interest on deposits, etc. Every state and territory except Nevada reported some income from these sources, but in no case was the amount large enough to represent any considerable proportion of the whole. The four states reporting the largest amounts were Pennsylvania, $172,440; California, $113,405; New York, $112,313; and Massachusetts, $90,683. The amounts derived by the municipal stations from "all other sources" and from "all other electric service" are too small to disturb any conclusions that might be arrived at with regard to the business done by the private stations.

Miscellaneous income of municipal stations.—Table 78 gives an analysis of the miscellaneous income from municipal stations, by states and territories. It has already been pointed out that the business of municipal plants is almost entirely restricted to arc and incandescent lighting, so that of the total gross income of $6,965,105 all but $216,242 was received from these sources. The analysis of the sum of $87,993, returned for all electric service other than arc and incandescent lighting, shows that $70,540 of it was derived from stationary motor service; $3,172 from electric railway operation; $58 from electric heating; $97 from charging automobiles; and $14,126 from all other electric service. The supply of current for motor work was more general than might have been expected, 28 states and territories reporting income under this head. The amounts were considerable in some states, being $10,720 in California, $7,660 in Michigan, $5,525 in Ohio, $5,430 in Texas, $5,376 in Florida, $4,621 in Washington, $4,373 in Vermont, and $3,776 in Massachusetts. Only two states, California and Missouri, reported the supply of current for street cars, while only one state, Vermont, reported income from electric heating. The earnings from the charging of automobiles were also extremely restricted. In respect to the residue, lumped together as "all other electric service," it may be noted that of the total, $14,126, almost the entire amount was returned by three states, namely, New York, $8,500; Ohio, $2,505; and Pennsylvania, $1,459. The entire amount credited to New York was for power for police patrol boxes, etc., in Buffalo.

Under the head of "all other sources" an income of $128,249 was reported by the municipal stations. This

EXTERIOR VIEW OF EARLY BRUSH ARC LIGHTING PLANT AT ELLSWORTH, MAINE.



INTERIOR VIEW OF EARLY BRUSH ARC LIGHTING PLANT AT ELLSWORTH, MAINE.

sum was quite generally distributed among the states and territories, although not less than $39,404 was reported for Michigan, $14,696 for Indiana, and $14,533 for Iowa. Other leading states were Missouri with $9,017, Ohio with $6,971, and California with $6,922—the last-named state showing for its municipal stations as well as its private stations a remarkable diversification of income and an unusually large proportion from sources other than the standard arc and incandescent lighting upon which so many of the stations, whether carried on under private ownership or by municipalities, are inclined to depend, either from lack of enterprise or from want of opportunity. Of this income, all for California was from the sale of supplies, from wiring, etc.; $14,000 of that in Michigan was reported by the Detroit plant as coming from rent of poles and conduits, inspection, and foreign work; and in Massachusetts almost the entire amount was from the rent of meters and poles and from the sale of steampower.

Income of stations, classified according to population of places in which located.—Tables 32 to 35 present the general statistics of income for purely electric and composite private stations, and for purely electric and composite municipal stations, grouped according to the population of the places in which located.

TABLE 32.—ANALYSIS OF INCOME—PURELY ELECTRIC PRIVATE STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	1,759	1,345	277	76	44	17
Gross income	$54,455,737	$9,654,207	$7,840,871	$8,521,413	$11,445,572	$16,993,674
Arc lighting, total	14,721,531	1,784,903	1,870,485	2,457,083	3,502,671	5,106,389
Commercial or other private	5,365,793	462,129	628,094	858,589	1,193,021	2,223,960
Public	9,355,738	1,322,774	1,242,391	1,598,494	2,309,650	2,882,429
Incandescent lighting, total	28,082,469	6,512,620	3,562,386	4,013,412	5,055,736	8,938,315
Commercial or other private	26,591,126	5,840,182	3,299,706	3,824,470	4,951,942	8,674,826
Public	1,491,343	672,438	262,680	188,942	103,794	263,489
Motor service	7,049,444	683,231	624,458	1,103,111	1,782,248	2,856,396
Electric railway service	1,869,569	153,512	477,294	556,396	645,015	37,352
Electric heating	6,064	3,740	835	100	207	1,182
Charging automobiles	26,245	286	332	630	13,997	11,000
All other electric service	1,638,836	274,925	1,072,898	78,232	212,781	.....
All other sources	1,061,579	240,990	232,183	312,449	232,917	43,040

It will be seen by Table 32 that the 1,759 purely electric private stations when treated on the basis of population fall very largely into the category of places of less than 5,000 inhabitants. There were 1,345 stations in such small towns and cities, and 1,622 in places having less than 25,000 inhabitants. The 1,345 stations had an aggregate income of $9,654,207, of which $1,784,903 was derived from arc lighting, and $6,512,620 from incandescent lighting. The other sources of income were all inconsiderable. A high proportion of income from lighting is shown in the group of places with between 5,000 and 25,000 inhabitants. The 277 stations in this class, with a gross income of $7,840,871, derived $1,870,485 from arc lighting and $3,562,386 from incandescent lighting. The miscellaneous sources of income, as will be seen from the table, were of more importance in this group, but were not so marked as in the next class of stations, namely, the 76 in places with between 25,000 and 100,000 inhabitants. Here the gross income was $8,521,413, with $2,457,083 derived from arc lighting and $4,013,412 from incandescent lighting, but the income from motor service reached $1,103,111, and that from electric railway service was $556,396. In fact, if all the items of miscellaneous service in this group be added together, they amount to $2,050,918, which is not greatly below the entire amount earned from arc lighting, and is far in excess of the amount derived from public arc lighting, a class of business upon which a great many stations of this size once depended almost wholly. The 44 purely electric private stations in cities of between 100,000 and 500,000 population had the large income of $11,445,572, with business well distributed through all the categories, namely: $3,502,671 from arc lighting; $5,055,736 from incandescent lighting; $1,782,248 from stationary motor service; and $645,015 from electric railway service.

The gross income for the 17 purely electric private stations in cities of a population of 500,000 and over formed a very large proportion of the total for all purely electric stations, namely, $16,993,674 out of $54,455,737.

The various sources of income seem to be much more carefully separated by the managements in this group than by those in any of the other groups, for out of a total income of $1,638,836 from "all other electric service," none is credited to the stations in this group; and out of the $1,061,579 income derived from "all other sources," only $43,040 is shown for this group. While the managements of these large stations undoubtedly are well informed as to the sources of income upon which their business is based, it is to be borne in mind that every one of these stations meters its current, so that it would be quite possible for part of the current going out over the incandescent lighting circuits to be credited to lamp consumption, although in fact it might be, and undoubtedly is, used for other purposes, which were duly noted in the smaller cities and towns. Some light is thrown on this point by a consideration of Table 43,

dealing with the per capita statistics of the 21 principal cities, including those 17 stations and some others of a composite character included in Table 6.

Table 33 deals with private stations operated in connection with other business.

TABLE 33.—ANALYSIS OF INCOME—COMPOSITE PRIVATE STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	1,046	698	277	39	23	9
Gross income	$24,279,763	$4,340,587	$7,317,687	$3,803,482	$5,537,380	$3,280,627
Arc lighting, total	7,370,269	878,602	2,393,938	1,333,139	2,113,129	651,461
Commercial or other private	2,854,361	232,731	762,557	538,001	882,267	438,805
Public	4,515,908	645,871	1,631,381	795,138	1,230,862	212,656
Incandescent lighting, total	13,215,015	3,066,862	3,779,997	1,941,962	2,387,984	2,038,210
Commercial or other private	12,448,431	2,799,312	3,540,084	1,825,121	2,280,399	2,003,515
Public	766,584	267,550	239,913	116,841	107,585	34,695
Motor service	2,790,233	229,973	718,342	428,467	841,032	572,419
Electric railway service	431,774	9,216	243,158	54,013	125,392	.....
Electric heating	33,091	2,183	6,435	2,144	22,329	.....
Charging automobiles	3,714	105	1,031	141	2,437	.....
All other electric service	111,495	56,844	28,001	.....	12,497	14,153
All other sources	324,172	96,802	146,790	43,616	32,580	4,384

It is found that 698, or two-thirds of the 1,046 stations enumerated, were in places of a population of less than 5,000. There were 975 composite stations located in communities of less than 25,000 inhabitants. As a general thing the statistics in this table do not call for extensive comment as presenting notable points of difference.

It is rather a coincidence that in the class of places with between 5,000 and 25,000 inhabitants there should be exactly the same number of purely electric and of composite stations, namely, 277, and that the gross income for the two groups should be so nearly the same. In this population group the income from arc lighting amounted to $1,870,485 out of an aggregate of $7,840,871 for the purely electric stations, while in the composite stations the income amounted to $2,393,938 out of a total of $7,317,687, the proportion of income being much higher. The 9 composite stations in the group of cities with a population of 500,000 and over were by no means of a magnitude to compare with that of the 17 purely electric stations in cities of the same size. These composite stations had an income of only $3,280,627 out of the grand total of $24,279,763, whereas the purely electric stations had an income of $16,993,674 out of a grand total of $54,455,737, the relative proportions being therefore more than one-eighth and less than one-third. It is possible, however, that this comparison does not do full justice to the composite stations, since it may not embrace all the facts. Electric railways doing an electric business are shown in Table 97 to have received an income of $6,271,815 from the sale of electric current for light and power, which amount, if it could be properly brought into the statistics of composite electric lighting stations, would give them a position of greater magnitude and importance. With regard to these composite stations it is also to be noted that in the class of 500,000 and over the three items of electric railway service, electric heating, and charging automobiles disappear entirely, while the income from all the miscellaneous sources is also quite inconsiderable, falling below $20,000. Apparently the statistical effect of selling current by meter rather than for specific purposes or at a special flat rate is here shown.

Tables 34 and 35, dealing with the income of municipal stations, are very instructive as to the smallness of communities served by such plants, whether purely electric or associated with other business.

TABLE 34.—ANALYSIS OF INCOME—PURELY ELECTRIC MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	380	288	73	10	6	3
Gross income[1]	$4,147,669	$1,526,686	$1,146,261	$378,094	$441,235	$655,393
Arc lighting, total	2,276,193	509,982	602,458	194,674	319,186	649,893
Commercial or other private	151,390	58,740	65,643	27,007	.....	.....
Public	2,124,803	451,242	536,815	167,667	319,186	649,893
Incandescent lighting, total	1,732,235	959,421	496,659	171,228	99,427	5,500
Commercial or other private	1,423,538	834,056	430,275	157,540	1,667	.....
Public	308,697	125,365	66,384	13,688	97,760	5,500
Motor service	51,075	13,556	24,796	12,137	586	.....
Electric railway service	3,172	.....	3,172	.....	.....	.....
Electric heating	58	58	.....	.....	.....	.....
Charging automobiles	20	20	.....	.....	.....	.....
All other electric service	13,686	5,062	124	.....	8,500	.....
All other sources	71,230	38,587	19,052	55	13,536	.....

[1] Includes estimated income from public lighting.

TABLE 35.—ANALYSIS OF INCOME—COMPOSITE MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	435	383	48	3	.....	1
Gross income[1]	$2,817,436	$2,094,337	$618,739	$77,110	.....	$27,250
Arc lighting, total	1,113,052	657,479	368,013	66,310	.....	21,250
Commercial or other private	88,776	64,231	24,545	.....	.....	.....
Public	1,024,276	593,248	343,468	66,310	.....	21,250
Incandescent lighting, total	1,627,383	1,382,849	227,734	10,800	.....	6,000
Commercial or other private	1,444,758	1,234,131	210,627	.....	.....	.....
Public	182,625	148,718	17,107	10,800	.....	6,000
Motor service	19,465	9,524	9,941	.....	.....	.....
Electric railway service	.....	.....	.....	.....	.....	.....
Electric heating	.....	.....	.....	.....	.....	.....
Charging automobiles	77	77	.....	.....	.....	.....
All other electric service	440	440	.....	.....	.....	.....
All other sources	57,019	43,968	13,051	.....	.....	.....

[1] Includes estimated income from public lighting.

Of the 380 purely electric municipal stations, no fewer than 361 were in places of less than 25,000 inhabitants and 288 of them were in places of less than 5,000. Of the 435 composite stations, all but 4 were in places of less than 25,000 inhabitants and 383 were in places of less than 5,000 inhabitants. The income attributable to the purely electric stations in places with a population of less than 25,000 was $2,672,947 out of a total of $4,147,669. In the composite stations the proportion for the smallest places is overwhelming, being $2,094,337 out of a total of $2,817,436.

The disappearance of miscellaneous sources of income in the smaller centers of population is also brought out clearly by these two tables. In several of the classes the miscellaneous items are entirely wanting. The 288 purely electric stations in communities of less than 5,000 inhabitants derived, out of a total income of $1,526,686, only $13,556 from motor service and nothing from electric railway service; while the 73 stations in communities with between 5,000 and 25,000 inhabitants earned only $24,796 from motor service and $3,172 from electric railway service. This lack of diversity of income is also apparent in the composite stations; the 383 plants of this character in communities of less than 5,000 inhabitants, out of a total income of $2,094,337, derived only $9,524 from motor service and nothing from electric railway service. It is remarkable, however, that as to the division of income between the two classes of lighting, arc and incandescent, the smallest communities make returns showing a higher percentage of incandescent lighting. The purely electric stations in communities of less than 5,000 inhabitants reported an income from arc lighting of $509,982, as compared with $959,421 from incandescent lighting. Such results, however, would appear to be attributable in some respects to the use of incandescent lamps instead of arcs for street lighting, which would tend to bring the incandescent income up to the expense of the arc income. The figures for these items are even more striking for the composite municipal stations; the stations in communities of less than 5,000 inhabitants reported only $657,479 for arc lighting and $1,382,849 for incandescent lighting. In communities in the next group the relations of the figures for these items are reversed, although the same conditions would presumably hold good and afford the same explanation. The effect of restricting the business of municipal stations to the supply of current for street lighting with arcs is exemplified in these tables by the statistics of stations in cities of 100,000 inhabitants and upward. The 3 purely electric municipal stations in cities with a population of 500,000 and over reported an aggregate income of $655,393, of which all but $5,500 was due to arc lighting, while the single composite plant in the same group reported an aggregate income of $27,250, of which all but $6,000 was earned by arc lighting. All 4 of these plants in the larger cities earned their incomes from incandescent lighting by supplying public necessities, and not from commercial service.

Income of stations, classified according to dynamo capacity.—Income is brought under further analysis in Tables 36 to 39, which embody a classification according to the horsepower capacity of dynamos in exclusively electric private stations, composite private stations, exclusively electric municipal stations, and composite municipal stations, respectively.

TABLE 36.—ANALYSIS OF INCOME—PURELY ELECTRIC PRIVATE STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.	2,000 but under 5,000.	5,000 and over.
Number of stations	1,759	1,026	445	121	78	56	33
Gross income	$54,455,737	$4,999,517	$5,582,411	$3,585,065	$5,102,347	$8,639,398	$26,546,999
Arc lighting, total	14,721,531	1,036,360	1,371,498	988,447	1,563,861	2,507,585	7,253,780
Commercial or other private	5,365,793	248,062	400,941	301,796	638,111	861,046	2,915,837
Public	9,355,738	788,298	970,557	686,651	925,750	1,646,539	4,337,943
Incandescent lighting, total	28,082,469	3,711,212	3,688,358	1,988,136	2,378,876	3,617,887	12,698,000
Commercial or other private	26,591,126	3,304,222	3,349,070	1,827,663	2,229,011	3,525,092	12,356,068
Public	1,491,343	406,990	339,288	160,473	149,865	92,795	341,932
Motor service	7,049,444	61,561	239,310	327,639	659,826	1,489,390	4,271,718
Electric railway service	1,869,569	36,198	62,143	206,357	219,354	420,989	924,528
Electric heating	6,064	274	439	3,637	225	100	1,389
Charging automobiles	26,245	36	250		462	500	24,997
All other electric service	1,638,836	6,831	31,392	4,207	115,096	369,692	1,111,618
All other sources	1,061,579	147,045	189,021	66,642	164,647	233,255	260,969

In Table 36 are presented the figures for the purely electric private plants, for which there was an aggregate income of $54,455,737 from all sources; the two principal sources were arc lighting with $14,721,531, and incandescent lighting with almost twice as much, namely, $28,082,469. The statistics for dynamos classified according to the various capacities show that 33 plants with a capacity of 5,000 horsepower and upward earned about one-half of the income, namely, $26,546,999, but that relatively the proportion of income from incandescent lighting to that from arc lighting in that group fell off slightly—the arc lighting income being $7,253,780, while the incandescent lighting was $12,698,000.

In the group of stations with dynamo capacity of less than 200 horsepower, incandescent lighting formed a surprisingly large proportion of the total, being $3,711,212 out of a total of $4,999,517. In the next group of 445 stations the aggregate income was $5,582,411, of which amount $1,371,498 was for arc lighting and $3,688,358 was for incandescent lighting. The aggregate income shown for the stations having a capacity of between 500 and 1,000 horsepower amounted to only $3,585,065, of which $988,447 represented arc lighting and $1,988,136 incandescent lighting. This group had the smallest earnings. The aggregate earnings of the group of 78 stations with between 1,000 and 2,000 horsepower were $5,102,347, of which $1,563,861 were from arc lighting and $2,378,876 from incandescent lighting. The group of 56 stations of between 2,000 and 5,000 horsepower capacity earned an aggregate of $8,639,398, of which $2,507,585 was for arc lighting and $3,617,887 was for incandescent lighting. A further study of the table shows that miscellaneous income was derived from stations in all classes, but that, as might be expected, the largest plants had by far the largest proportion of income derived from other sources than mere lighting. Thus the 33 plants of 5,000 horsepower and over, out of a total income of $26,546,999, showed $6,595,219, or 24.8 per cent, derived from the various miscellaneous services and sources of income.

On the other hand the stations having a dynamo capacity of less than 200 horsepower and earning a gross income of $4,999,517 reported a total income from miscellaneous sources of only $251,945. This is only 5 per cent. Many of the causes that have already been suggested would account for this. The leading factor, of course, is the general absence of day circuits in connection with such small plants as a result of the scarcity of local industries and enterprises calling for current in the daylight hours. This point is emphasized by the fact that these stations earned only $61,561 from the supply of current to stationary motors, or about $60 a year each; this condition of affairs shows that the business "in sight" was either entirely negligible or that no effort had been made to work it up. As the plants grow in size these hampering conditions tend to ameliorate, as shown by this table. For example, in plants of between 200 and 500 horsepower dynamo capacity, out of a gross income of $5,582,411, the income from miscellaneous sources was $522,555, or 9.4 per cent. In the group with a capacity between 500 and 1,000 horsepower, out of a gross income of $3,585,065, the income from all miscellaneous sources was $608,482, or 17 per cent. In the next group—that of plants of between 1,000 and 2,000 horsepower capacity—out of a gross income of $5,102,347, the miscellaneous income was $1,159,610, or 22.7 per cent. In the group of stations of between 2,000 and 5,000 horsepower capacity the gross income was $8,639,398 and the income derived from all miscellaneous sources was $2,513,926, or 29.1 per cent. It is thus made very clear that there is from the smallest station upward a sharp increase in the percentage of income derivable from business other than lighting, the probability being that the percentages for the two classes with a capacity of more than 2,000 horsepower are more nearly alike than they appear to be on the surface. Both groups illustrate the steady advance toward securing a large amount of business in the daytime and a high load factor for the system throughout the twenty-four hours.

Table 37 deals with private stations operated in connection with other business.

EARLY THOMSON-HOUSTON ARC LIGHTING STATION AT LOWELL, MASS., BELT DRIVEN.

TABLE 37.—ANALYSIS OF INCOME—COMPOSITE PRIVATE STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.	2,000 but under 5,000.	5,000 and over.
Number of stations	1,046	624	255	80	48	25	14
Gross income	$24,279,763	$2,925,026	$3,869,430	$2,653,918	$3,353,809	$2,763,587	$8,714,043
Arc lighting, total	7,370,269	672,777	1,163,709	850,469	1,158,251	848,667	2,676,396
Commercial or other private	2,854,361	152,259	351,770	295,528	414,098	324,382	1,316,324
Public	4,515,908	520,518	811,939	554,941	744,153	524,285	1,360,072
Incandescent lighting, total	13,215,015	2,105,263	2,345,172	1,397,354	1,670,560	1,305,166	4,391,500
Commercial or other private	12,448,431	1,908,256	2,201,970	1,321,753	1,555,464	1,201,569	4,259,419
Public	766,584	197,007	143,202	75,601	115,096	103,597	132,081
Motor service	2,790,233	79,035	206,215	275,401	351,234	438,517	1,439,831
Electric railway service	431,774	7,811	48,419	80,007	97,572	41,214	156,751
Electric heating	33,091	2,020	163	6,000	22,704	1,654	550
Charging automobiles	3,714	105	670	547	.....	80	2,312
All other electric service	111,495	6,320	16,096	.....	4,520	72,062	12,497
All other sources	324,172	51,695	88,986	44,140	48,968	56,177	84,206

In this group 1,046 stations are included with a gross income of $24,279,763, of which $7,370,269 resulted from arc lighting and $13,215,015 from incandescent lighting. Thus in the composite stations $20,585,284, or 84.8 per cent of the income, was derived from lighting. These figures compare rather strikingly with those for the purely electric stations, which with a gross income of $54,455,737 had an income from lighting alone of $42,804,000, or only 78.6 per cent. The inference is that the purely electric stations as a whole had a more diversified business and more varied sources of income than the composite stations.

The 14 composite stations of a dynamo capacity of at least 5,000 horsepower had an income from all miscellaneous sources of $1,646,147, or 18.9 per cent, out of a total of $8,714,043. This compares with 24.8 per cent in the corresponding class among purely electric stations. It is interesting to note, moreover, that while the 33 stations in the largest group in the purely electric class earned about one-half of the total income for that class, the composite stations of the same rank earned only a little more than one-third of the income of composite stations.

From the fact that composite stations are those which are carried on in connection with other business, it would be fair to infer that it would be much easier for the smaller stations in this group to render service in the daytime than it would be for the purely electric stations of the same minor magnitude, for the reason that the steam or water plant would presumably be in operation all the time, and that it would therefore be a matter of no great difficulty to throw a small dynamo onto the shafting and into circuit to supply current for light, power, and other service. This inference, however, is not borne out as fully as might be expected by the figures shown in this table, although the influence of the lack of daylight demand can be understood. For instance, the 1,026 purely electric stations of less than 200 horsepower capacity derived $61,561 from motor service and $36,198 from electric railway service, 1.2 and seven-tenths of 1 per cent, respectively, of their total income, while the 624 composite stations of less than 200 horsepower capacity earned from motor service $79,035, which was 2.7 per cent of their income, but secured from electric railway work only $7,811, or three-tenths of 1 per cent of the income. Leaving the supply of current to electric railways out of consideration, however, it would appear that the smaller stations, namely, all those with a dynamo capacity below 1,000 horsepower, did relatively a larger amount of motor business. In the purely electric class the three groups, with a capacity below 1,000 horsepower, earned $628,510 from stationary motor service, only slightly over 4 per cent of their gross income. The corresponding stations below 1,000 horsepower dynamo capacity in the composite class derived an income from motor service of $560,651, or not quite 6 per cent. A greater difference in favor of the composite class might have been expected.

In Table 38 are presented analyses similar to the above, for purely electric municipal stations.

TABLE 38.—ANALYSIS OF INCOME—PURELY ELECTRIC MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.	2,000 but under 5,000.	5,000 and over.
Number of stations	380	269	78	22	8	2	1
Gross income[1]	$4,147,669	$1,340,157	$925,398	$595,141	$554,156	$228,389	$504,433
Arc lighting, total	2,276,193	539,058	502,879	223,020	321,014	186,289	503,933
Commercial or other private	151,390	37,168	42,143	42,525	29,554	.....	.....
Public	2,124,803	501,890	460,736	180,495	291,460	186,289	503,933
Incandescent lighting, total	1,732,235	759,744	394,439	324,674	224,450	28,428	500
Commercial or other private	1,423,538	641,433	344,372	292,431	144,604	698	.....
Public	308,697	118,311	50,067	32,243	79,846	27,730	500
Motor service	51,075	6,693	7,838	27,934	8,474	136	.....
Electric railway service	3,172	.....	.....	3,172	.....	.....	.....
Electric heating	58	50	8	.....	.....	.....	.....
Charging automobiles	20	20	.....	.....	.....	.....	.....
All other electric service	13,686	9,983	3,603	100	.....	.....	.....
All other sources	71,230	24,609	16,626	16,241	218	13,536	.....

[1] Includes estimated income from public lighting.

The 380 purely electric stations enumerated had a gross income of $4,147,669, of which $2,276,193 was derived from arc lighting and $1,732,235, from incandescent lighting. These stations derived from miscellaneous business of all kinds an income of only $139,241, which is barely over 3 per cent of the gross income. On the other hand, a noteworthy reversal of conditions is implied in the statistics as to the two classes of lighting. In the private stations, both purely electric and composite, the income derived from incandescent lighting was very much in excess of that from arc lighting, being almost twice as much; whereas in the purely electric municipal stations, the income from incandescent lighting was considerably less than that from arc lighting, being for the latter $2,276,193, as compared with $1,732,235 for the former. As will be noted later, the composite municipal stations in some respects more nearly resemble the composite private stations.

The horsepower classification of municipal plants brings out very clearly the preponderating character and influence of the smaller plants. The reports showed but one plant of a capacity above 5,000 horsepower, and its income was only 12.2 per cent of the total for the 380 plants included. On the other hand, the 33 purely electric private stations of similar capacity enjoyed 48.7 per cent of the total income of the 1,759 stations of their own character. The 269 purely electric municipal stations of less than 200 horsepower had a gross income of $1,340,157, or 32.3 per cent of the total for all stations. In fact, the two groups most prominent as to earnings are those of less than 200 horsepower and those of between 200 and 500 horsepower, the latter class with 78 stations showing a gross income of $925,393. These two groups, in fact, had a gross income of more than one-half of all the income of their class.

Table 39 shows the analysis of the income of municipal stations operated in connection with other business.

TABLE 39.—ANALYSIS OF INCOME—COMPOSITE MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000	2,000 but under 5,000.	5,000 and over.
Number of stations	435	343	86	3	3	.....	.....
Gross income[1]	$2,817,436	$1,679,501	$959,479	$77,154	$101,302	.....	.....
Arc lighting, total	1,113,052	639,914	399,631	46,286	27,221	.....	.....
Commercial or other private	58,776	40,714	13,716	.....	4,346	.....	.....
Public	1,024,276	599,200	355,915	46,286	22,875	.....	.....
Incandescent lighting, total	1,627,383	1,004,832	524,449	30,568	67,534	.....	.....
Commercial or other private	1,444,758	886,489	471,090	20,775	66,404	.....	.....
Public	182,625	118,343	53,359	9,793	1,130	.....	.....
Motor service	19,465	7,205	6,470	300	5,490	.....	.....
Electric railway service	.....	.....	.....	.....	.....	.....	.....
Electric heating	.....	.....	.....	.....	.....	.....	.....
Charging automobiles	77	77	.....	.....	.....	.....	.....
All other electric service	440	40	400	.....	.....	.....	.....
All other sources	57,019	27,433	28,529	.....	1,057	.....	.....

[1] Includes estimated income from public lighting.

Of the private stations 1,759 were purely electric and only 1,046 were composite; the proportion, however, is reversed in the case of the municipal stations, 380 of these being purely electric while 435 were composite. This excess of composite stations is due to the very general tendency to operate several municipal enterprises together, which, while it has its advantages in an economic sense, renders difficult the segregation of figures relative to any branch or department. According to the classification in this table, 343 stations, with an income of $1,679,501, or considerably more than half the total income for the class, had a dynamo capacity of less than 200 horsepower. In fact, all but 6 of the composite stations were of a capacity below 500 horsepower, and the income of these 429 stations was $2,638,980, or an average of $6,151, a very clear indication of the small magnitude of business done by the average plant of this character. It is to be noted that the electric motor service income was very small, namely, only $19,465, or less than 1 per cent of the gross income; this fact is somewhat counter to the deductions drawn from the previous table, and would indicate that while the purely electric stations, under whatever form of administration, cultivated a miscellaneous and diversified daytime business, the municipal stations of a composite physical character have neglected outside business altogether. This is explained by the obvious reason that the majority of these plants are in very small communities where there is no call for anything electric more than public lighting, and where even that is restricted to a limited number of arc or incandescent lamps. It is a little curious, however, to note that a few of these small plants had established the beginning of a business in electric heating and charging of automobiles.

Average income per horsepower of dynamo capacity.—For the various states and territories the details of income as to earnings from operation are presented, for

all stations, in Table 66; for private stations separately in Tables 67 and 68; and for municipal stations separately in Tables 77 and 78. Other general tables present different aspects of the subject.

The earnings from sale of current by the private stations amounted to $77,349,749, and this amount represents the earning power of the dynamo electric machinery installed. The earnings follow capacity with fair closeness, although the extent of equipment varies in the different states, being especially large in the more densely populated parts of the country, and particularly in the Northern states.

New York, with a dynamo capacity in private stations of 245,823 horsepower, reported earnings from sale of current of $16,519,489, which gives average annual earnings per dynamo horsepower of $67.20. Pennsylvania, with 155,377 horsepower and earnings of $8,885,063, had an average of $57.18 per horsepower. Missouri, with 37,150 horsepower and earnings of $2,098,622, showed an average of $56.49 per horsepower. New Jersey, with 60,361 horsepower, reported earnings of $3,313,946, or $54.90 per horsepower. Massachusetts, with 114,928 horsepower and earnings of $5,979,960, averaged $52.03 per horsepower. Illinois, with 110,334 horsepower and earnings of $5,514,569, averaged $49.98, while for Ohio, with 76,276 horsepower and earnings of $3,652,778, the figure was $47.89. California, with 110,381 horsepower and earnings of $4,824,039, averaged $43.70 per horsepower, while Michigan, with 42,133 horsepower and earnings amounting to $1,798,106, averaged $42.68 per horsepower. It would hardly be expected that the average for Alabama would be higher than that for Connecticut, and nearly as high as that for New York, but the returns show this to be the case; the average for Alabama was $64.25 per horsepower, as compared with $67.20 for New York and $62.70 for Connecticut, for which state the horsepower was 20,279 and the income from the sale of current $1,271,576. There was a high average also in North Dakota, which had a capacity of 2,096 horsepower and earnings of $142,891, and therefore an average of $68.17 per horsepower.

Such variations seem to prove the existence of much higher rates in some localities than in others where there is not a large volume of business, although in some cases they might also be due to the fact that while some managements carry considerable reserve capacity in their stations as a safeguard against interruption by breakdown, others operate all the plant installed to its highest point of output, depending upon vigilance and good fortune to escape trouble. In some instances, also, the returns for the plant were made at a time when additions had become necessary but had not yet been installed, with the result that the station appears to have had an earning power much above its average.

From such figures as these it is obviously very difficult to deduce any general rule or formulate any statement which would be both exact and comprehensive as to the conditions under which the plants were or can be operated to the greatest financial advantage. The subject is considered later with respect to the earning power of the consumption apparatus to which current is distributed, with additional data and suggestions useful as bearing upon features of management and the benefit afforded to the public, as well as the profit to the station from the cultivation of certain lines of business.

Average income per kilowatt hour.—It is interesting to look at the earning capacity of dynamos from another point of view, namely, that of their gross output of current and the value of said current to the central stations producing it. The output in current of private stations with a dynamo capacity of 1,472,996 horsepower was reported in Table 1 as being 2,311,146,676 kilowatt hours for the year. This output earned $77,349,749. This would represent 3.35 cents per kilowatt hour, without taking into account how much of the kilowatt hour output was actually delivered to the customer and registered by his meter or sold at a flat rate. Such a return is very far below the average price obtained for current supplied in limited quantities to the small consumer, thus indicating a relatively low return per unit of current.

The output for municipal stations was returned at 195,904,439 kilowatt hours, and the income from sale of current including the estimated income from public service, at $6,836,856. These figures show an earning per kilowatt hour for the municipal stations of 3.49 cents, which average it will be noted does not differ greatly from the corresponding earnings for private stations. A less close approximation than this, favoring the municipal plants, might have been expected in view of the assumed lower capitalization and fixed charges, etc., upon which the municipal stations have to operate.

The income varied from one state to another, although not in such a manner as to afford a common rule or basis. For example, in New York the earnings per kilowatt hour for private stations were only 2.38 cents. It will be recalled that the state of Alabama showed almost as high earning per horsepower of dynamo capacity as New York, but the earnings per kilowatt hour were only 3.12 cents. The output in California was 150,338,307 kilowatt hours and the earnings from operation, $4,824,039, which gives an average of 3.2 cents. Kilowatt hour earnings for other leading states may be noted as follows: Pennsylvania, 3.86 cents; Illinois, 4.12 cents; Massachusetts and Connecticut, 4.91 cents each; New Jersey, 4.26 cents; Iowa, 4.12 cents; Washington, 3.15 cents; Michigan, 3.12 cents; Maine, 3.06 cents; and New Hampshire, 3.04 cents.

Cost and income of stations, classified according to kind of power used.—It will have been noticed from preceding tables that a considerable part of the central station industry is based upon the utilization of water-power. More exact figures bearing upon this point are to be found in Tables 40 and 41, which present statistics of private and municipal stations under the heads of stations operating by steampower exclusively, stations operating by steam and water power conjointly, and stations operating by waterpower exclusively. The last class, those in which waterpower alone is employed for power purposes, is shown by states in Table 42.

TABLE 40.—STATISTICS OF PRIVATE STATIONS, CLASSIFIED ACCORDING TO KIND OF POWER USED: 1902.

	Total.	KIND OF POWER USED.		
		Steam exclusively.	Water and steam.	Water exclusively.
Number of stations	2,805	2,211	316	278
Cost of construction and equipment	$482,719,879	$324,267,907	$121,230,534	$37,221,438
Gross income	$78,735,500	$62,402,880	$12,448,955	$3,883,665
Income from sale of current	$77,349,749	$61,459,052	$12,118,835	$3,771,862
Arc lighting, total	$22,091,800	$18,213,239	$3,452,975	$425,586
Commercial or other private	$8,220,154	$6,771,656	$1,290,043	$158,455
Public	$13,871,646	$11,441,583	$2,162,932	$267,131
Incandescent lighting, total	$41,297,484	$34,267,778	$5,542,223	$1,487,483
Commercial or other private	$39,039,557	$32,436,310	$5,207,661	$1,395,586
Public	$2,257,927	$1,831,468	$334,562	$91,897
All other electric service	$13,960,465	$8,978,035	$3,123,637	$1,858,793
Income from all other sources	$1,385,751	$943,828	$330,120	$111,803
Total expenses[1]	$50,716,648	$39,804,490	$8,600,271	$2,311,887
Salaries and wages	$18,766,970	$14,528,959	$3,116,580	$1,121,431
Cost of supplies and materials	$8,296,763	$5,731,661	$2,283,741	$281,361
Cost of fuel	$10,189,685	$9,065,375	$1,119,505	$4,805
Rent of power	$2,007,193	$1,418,459	$322,522	$266,212
Rents, taxes, insurance, and miscellaneous expenses	$11,456,037	$9,060,036	$1,757,923	$638,078
Salaried officials, clerks, etc.:				
Number	6,046	4,759	898	389
Salaries	$5,206,199	$3,991,895	$870,754	$343,550
Wage-earners:				
Average number	20,863	16,711	2,976	1,176
Wages	$13,560,771	$10,537,064	$2,245,826	$777,881
Power plant equipment:[2]				
Steam and gas engines—				
Number	5,017	4,445	572	.....
Horsepower	1,244,147	1,080,938	163,209	.....
Water wheels—				
Number	1,308	.....	754	554
Horsepower	427,254	.....	219,123	208,131
Generating plant equipment:				
Dynamos—				
Number	10,662	8,356	1,636	670
Horsepower	1,472,996	1,007,858	299,865	165,273
Direct current, constant voltage—				
Number	3,405	2,753	480	172
Horsepower	418,913	339,824	63,617	15,472
Direct current, constant amperage—				
Number	2,957	2,362	502	93
Horsepower	157,768	125,728	27,827	4,213
Alternating and polyphase current—				
Number	4,300	3,241	654	405
Horsepower	896,315	542,306	208,421	145,588
Output of stations, kilowatt hours, total for year	2,311,146,676	1,387,265,622	675,131,386	248,749,668
Number of arc lamps	334,903	273,166	54,360	7,377
Number of incandescent lamps	16,616,593	13,960,076	2,145,101	511,416

[1] Exclusive of interest on bonds amounting to $12,118,740.
[2] Does not include 329 auxiliary steam engines with a total capacity of 13,619 horsepower.

It will be seen from Table 40 that of the 2,805 private stations whose cost of construction and equipment was $482,719,879, 2,211, costing $324,267,907, employed steam exclusively; 316, costing $121,230,534, employed water and steam conjointly; and 278, or almost 10 per cent, were operated by waterpower exclusively, their cost of construction and equipment being $37,221,438. The earnings from the sale of current by these three groups were $61,459,052, $12,118,835, and $3,771,862, respectively.

In like manner Table 41 furnishes an interesting classification of municipal stations according to the kind of power used.

TABLE 41.—STATISTICS OF MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO KIND OF POWER USED: 1902.

	Total.	KIND OF POWER USED.		
		Steam exclusively.	Water and steam.	Water exclusively.
Number of stations	815	768	13	34
Cost of construction and equipment	$22,020,473	$20,351,416	$601,056	$1,068,001
Gross income	$6,965,105	$6,530,125	$184,229	$250,751
Income from sale of current[1]	$6,836,856	$6,413,878	$181,227	$241,751
Arc lighting, total[1]	$3,389,245	$3,213,711	$88,813	$86,721
Commercial or other private	$240,166	$219,179	$13,505	$7,482
Public[2]	$3,149,079	$2,994,532	$75,308	$79,239
Incandescent lighting, total	$3,359,618	$3,126,003	$89,733	$143,882
Commercial or other private	$2,868,296	$2,657,820	$81,964	$128,512
Public[2]	$491,322	$468,183	$7,769	$15,370
All other electric service	$87,993	$74,164	$2,681	$11,148
Income from all other sources	$128,249	$116,247	$3,002	$9,000
Total expenses[3]	$4,741,182	$4,466,711	$137,441	$137,030
Salaries and wages	$1,879,722	$1,768,404	$46,255	$65,063
Cost of supplies and materials	$852,901	$766,628	$48,219	$38,054
Cost of fuel	$1,445,824	$1,422,962	$22,341	$521
Rent of power	$123,566	$105,987	$5,980	$11,599
Rents, taxes, insurance, and miscellaneous expenses	$439,169	$402,730	$14,646	$21,793
Salaried officials, clerks, etc.:				
Number	950	881	19	50
Salaries	$457,381	$425,688	$11,161	$20,532
Wage-earners:				
Average number	2,467	2,325	55	87
Wages	$1,422,341	$1,342,716	$35,094	$44,531
Power plant equipment:[4]				
Steam and gas engines—				
Number	1,078	1,060	18	.....
Horsepower	147,975	144,851	3,124	.....
Water wheels—				
Number	82	.....	24	58
Horsepower	11,218	.....	2,088	9,130
Generating plant equipment:				
Dynamos—				
Number	1,822	1,701	41	80
Horsepower	151,984	141,369	3,900	6,715
Direct current, constant voltage—				
Number	418	395	7	16
Horsepower	23,533	22,524	439	570
Direct current, constant amperage—				
Number	582	543	19	20
Horsepower	37,763	35,948	1,183	632
Alternating and polyphase current—				
Number	822	763	15	44
Horsepower	90,688	82,897	2,278	5,513
Output of stations, kilowatt hours, total for year	195,904,439	177,281,083	8,674,893	9,948,463
Number of arc lamps	50,795	47,765	1,347	1,683
Number of incandescent lamps	1,577,451	1,433,023	55,906	88,522

[1] Includes estimated income from public lighting.
[2] Value estimated according to prevailing rates.
[3] Exclusive of interest on bonds amounting to $504,805.
[4] Does not include 36 auxiliary steam engines with a total capacity of 835 horsepower.

Of the 815 stations, costing $22,020,473, 768, costing $20,351,416, were operated by steam exclusively; 13, costing $601,056, employed both water and steam; while 34 depended upon water exclusively, their cost being $1,068,001. The earnings from the sale of current in these three classes were $6,413,878, $181,227, and $241,751, respectively. The other details of this table are of general interest, but need not be cited here.

The statistics of the group of exclusively waterpower stations, as developed in Table 42, are worthy of study.

TABLE 42.—CENTRAL ELECTRIC STATIONS OPERATED BY WATERPOWER EXCLUSIVELY, BY STATES: 1902.

	Total.	California.	New York.	Montana.	Washington.	Utah.	Michigan.	Maine.	All other states.[1]
Number of stations	312	29	37	9	9	10	35	20	163
Cost of construction and equipment	$38,289,439	$16,588,869	$3,925,234	$3,241,727	$1,992,155	$1,380,080	$1,117,891	$1,184,289	$8,859,244
Gross income	$4,134,416	$1,095,549	$529,838	$363,059	$353,031	$126,937	$242,416	$203,576	$1,220,010
Income from sale of current	$4,013,613	$1,082,888	$503,170	$359,620	$334,674	$126,937	$230,243	$191,552	$1,184,529
Arc lighting	$512,307	$42,338	$79,509	$14,715	$63,344	$1,626	$78,149	$37,919	$194,707
Incandescent lighting	$1,631,365	$273,594	$202,120	$74,299	$147,761	$31,366	$142,875	$124,233	$635,117
All other electric service	$1,869,941	$766,956	$221,541	$270,606	$123,569	$93,945	$9,219	$29,400	$354,705
Income from all other sources	$120,803	$12,661	$26,668	$3,439	$18,357	.....	$12,173	$12,024	$35,481
Salaried officials, clerks, etc.:									
Number	439	70	49	15	34	24	35	32	180
Salaries	$364,082	$95,314	$48,877	$25,651	$31,018	$18,745	$17,919	$16,258	$110,300
Wage-earners:									
Average number	1,263	248	324	54	55	44	84	77	377
Wages	$822,412	$208,377	$180,656	$50,433	$47,823	$24,278	$42,883	$43,587	$224,375
Water wheels:									
Number	612	91	66	30	35	15	57	34	284
Horsepower	217,261	61,904	35,347	21,220	16,353	9,410	7,940	7,241	57,846
Dynamos:									
Number	750	81	101	28	48	16	80	61	335
Horsepower	171,988	50,820	17,051	16,238	14,260	7,639	6,424	7,089	52,467
Output of stations, kilowatt hours, total for year	258,698,131	68,717,195	72,927,250	22,785,330	11,850,744	10,343,378	7,329,949	6,418,310	58,325,975
Number of arc lamps	9,060	572	1,383	196	1,087	39	1,635	878	3,270
Number of incandescent lamps	599,938	67,407	78,395	13,492	34,792	11,056	77,280	56,005	261,511

[1] Includes stations distributed as follows: Arkansas, 1; Colorado, 4; Connecticut, 6; Georgia, 6; Idaho, 5; Illinois, 3; Indiana, 1; Iowa, 2; Kansas, 3; Kentucky, 1; Massachusetts, 5; Minnesota, 6; Nebraska, 8; Nevada, 2; New Hampshire, 17; New Jersey, 4; New Mexico, 1; North Carolina, 7; Ohio, 3; Oregon, 10; Pennsylvania, 7; South Carolina, 1; South Dakota, 3; Tennessee, 4; Texas, 4; Vermont, 16; Virginia, 7; West Virginia, 1; Wisconsin, 24; Wyoming, 1.

In this table 312 private and municipal stations are dealt with collectively. It will be seen that 149, or nearly one-half, of these plants were in seven states, namely, New York, Michigan, California, Maine, Utah, Montana, and Washington, leaving 163 distributed among the other states. The total cost of construction and equipment for these 312 stations was reported as $38,289,439, or an average of $122,723 per station. For these stations the income from the sale of current was $4,013,613, and that from all other sources was $120,803. It is rather interesting to note that nearly one-half of the income was derived from all other electric service.

It is interesting to note also the cost of power plant equipment as related to motive power. As given in Table 1, the total horsepower capacity of all classes of prime movers, excluding possible "auxiliaries," in central stations, was 1,818,413 horsepower. The cost of construction and equipment was $504,740,352. This would give a cost of slightly over $278 per horsepower. It is instructive to compare this with the figures for stations using waterpower exclusively, which show an average of $176 per horsepower. It is not possible to arrive at an exact determination of all the steam plants as compared with all the water plants, for the reason that a considerable number of stations employ both steam and water, and the extent to which each power is used in the composite stations is not shown in the tables. It is fair, however, to infer from the statistics just given that it has been found economical and profitable to install the waterpower plants, and that where waterpower is available in an engineering sense it is a matter of business prudence to utilize it. As a matter of fact, the average cost of construction and equipment per horsepower in some of the plants using both steam and water power is relatively high, for the reason that the steam equipment has not been put in to assist in carrying a part of the load regularly, but because in seasons of drought or periods of low water the steam plant has been an absolute necessity as a safeguard against shutting down the station and leaving the customers without current. To this extent the economic value of waterpower for central station work is vitiated, for the success of such enterprises depends vitally upon a steady and uninterrupted supply of current, whether the station operates only during the hours of darkness or undertakes also to supply the wants of a locality as to current for traction, motive power for factories, and other general utilitarian purposes.

The average cost of construction and equipment of both private and municipal stations is shown in the following statement, classified according to the different kinds of power used:

Average cost of stations, classified according to motive power used: 1902.

MOTIVE POWER.	Private stations.	Municipal stations.
Total	$172,093	$27,019
Steam exclusively	146,661	26,499
Steam and water combined	383,641	46,235
Water exclusively	133,890	31,412

This statement shows that while the average cost of construction and equipment of private stations using steampower or waterpower exclusively was $146,661 and $133,890, respectively, those using both kinds of power averaged more than twice the amount for either of the others. The averages for the municipal stations show the same tendency, but in a less striking degree.

In connection with the financial statistics of waterpower stations, a few further interesting figures are derived from Table 42. It would appear from Table 1 that the output per horsepower of power plant equipment of all the central stations, regardless of the nature of power and of the ownership, was 1,378 kilowatt hours. Table 42, giving waterpower exclusively, shows an output of 1,190 kilowatt hours per horsepower of water wheel equipment. Moreover, the earnings per horsepower of power plant equipment of all stations were $45 per year, while the earnings of exclusively waterpower stations were only $18 per year. This is at the rate of 3.3 cents per kilowatt hour for all stations and only 1.5 cents per kilowatt hour for waterpower plants, considered separately. The higher cost of construction for steam plants, as well as their higher rate of earnings, is naturally explained to a large extent by the fact that they are installed under heavy expense in cities and busy centers of population, where land, labor, etc., cost more, whereas the waterpower plants are almost invariably more or less remote from urban districts and the large mass of consumers. But while the earnings per horsepower of $18 for waterpower plants may seem small, as compared with $55 for steam plants, it does not follow that the business of one group is on a less profitable basis than that of the other. The difference in the earnings per kilowatt hour indicates the ability of the waterpower plants to operate on a much lower basis of earnings than that required by the fuel consuming steampower, because, after the plants have once been installed, electric energy can be produced more economically by the waterpower plants.

Income in the leading cities.—In connection with the subject of income, the most interesting information is that connected with the large cities. It is in these cities, necessarily, that the electric lighting industry has attained its greatest development, the industry being one

which, during the earlier period of development, has been restricted to urban areas, as distinguished from rural. The small town or village has few streets that require elaborate or protracted illumination. The simpler habits of the people have limited the number of hours of darkness when light is required, and there are very few industries in which current for electric motors could be applied. Of late years the adoption of alternating current has greatly changed the conditions, so that even while the community may not deem it necessary to illumine its main thoroughfares properly, it is by no means unusual to find the electric light in modest cottages and scattered farmhouses, while the electric motor is being applied to agricultural work and to a variety of industries other than those of a manufacturing character. In addition to Table 6, which has already been discussed and which presents the general statistics, including capitalization and other items for New York, Chicago, St. Louis, Boston, Philadelphia, and Baltimore, comprising 30 stations, the extent to which the importance and success of the electric light and power industry is based upon the patronage extended to it in the principal cities is shown in the following table, which gives the per capita income, power and generating capacity, output of current, and the number of arc and incandescent lamps for 21 of the leading cities of the country. In order to avoid disclosing the operations of individual stations, several cities have been combined in showing the statistics in the table.

TABLE 43.—*Per capita income, power and generating capacity, output of current, and the number of arc and incandescent lamps of central stations, for selected cities: 1902.*

CITY.	Population.	PER CAPITA.					
		Income from sale of current.	Horsepower capacity of power plant.	Horsepower capacity of generating plant.	Output of current (kilowatt hours).	Number of arc lamps.	Number of incandescent lamps.
Total	11,892,177	$2.66	0.038	0.033	52.61	0.012	0.568
New York	3,437,202	2.86	0.033	0.022	44.60	0.008	0.748
Chicago	1,698,575	2.09	0.028	0.029	39.73	0.011	0.421
St. Louis	575,238	2.20	0.037	0.037	49.68	0.013	0.595
Boston	560,892	3.80	0.059	0.061	92.78	0.017	0.910
Cleveland	381,768	1.62	0.036	0.025	41.40	0.010	0.303
Buffalo	352,387	2.76	0.004	0.018	32.31	0.012	0.226
San Francisco	342,782	4.51	0.143	0.128	160.59	0.021	0.930
Louisville	204,731	2.31	0.045	0.049	72.99	0.012	0.283
Indianapolis	169,164	1.94	0.035	0.034	59.44	0.015	1.533
Rochester	162,608	5.11	0.139	0.089	159.66	0.032	0.584
Cincinnati and Detroit	611,606	2.48	0.044	0.042	56.21	0.019	0.565
Philadelphia, Pittsburg, and Providence	1,790,910	3.02	0.038	0.034	54.03	0.014	0.491
Baltimore, Washington, and New Orleans	1,074,779	1.87	0.027	0.026	36.56	0.009	0.278
Minneapolis, St. Paul, and Kansas City	529,535	2.08	0.026	0.021	38.92	0.013	0.316

According to the census of 1900 the population in these cities ranged from 3,437,202 in New York to 162,608 in Rochester, the total being 11,892,177. As already pointed out, many of the stations serve some population outside the corporate limits of the places in which they are located, but for the larger cities it is believed that the number is not sufficiently large to substantially vitiate the average. The average income per capita of these cities was $2.66. The variations above and below this amount are great, the extremes being $5.11 for Rochester and $1.62 for Cleveland. The high average in Rochester is undoubtedly attributable in large measure to the extensive and cheap utilization of the Genesee Falls waterpower by central stations in that city. High averages per capita are also shown for San Francisco and Boston, for which cities the figures are $4.51 and $3.80, respectively. The average for Philadelphia, Pittsburg, and Providence was $3.02, being considerably higher than the averages for all the cities. It would be impossible, without probing very deeply, to find explanations for the variations here brought to light, but, generally speaking, this table should be stimulating to the energies of the local station in places where the per capita consumption falls as low as it does in many instances.

If Buffalo be excepted, the horsepower capacity of power plant per capita ranges from 0.026 horsepower in Minneapolis, St. Paul, and Kansas City to 0.139 for Rochester and 0.143 for San Francisco. The averages for New York, St. Louis, Cleveland, Indianapolis, and the group of Philadelphia, Pittsburg, and Providence approximate the average for all the cities. The generating capacity per capita ranges from as low as 0.018 horsepower in Buffalo to as high as 0.128 horsepower in San Francisco; other high averages are 0.089 for Rochester and 0.061 for Boston.

It will be seen that in New York city, Chicago, Philadelphia, Baltimore, Cleveland, New Orleans, Minneapolis, St. Paul, and Kansas City the per capita is in the vicinity of 0.025 horsepower.

The kilowatt hour output depends somewhat on the productive capacity of the plants, although in view of what has been said it will be understood that a company can have an output of current all of which it does not generate, while, on the other hand, unless the population actually served is taken into consideration, the apparent consumption per capita—which is the equivalent of output—would rise to abnormal proportions. Thus, in the city of Rochester, the per capita kilowatt hour output is given as 159.66; in San Francisco, 160.59. A glance at the table will show that these are far above the average. For example, the per capita in New York is 44.60 kilowatt hours, and, disregarding

the decimals, runs as follows in other cities: 92 in Boston, 89 in Pittsburg, 72 in Louisville, 66 in Cincinnati, 54 in Washington, and 59 in Indianapolis.

Lamps per capita and income.—The columns as to proportion of lamps per capita have their bearing on the question of income, and that group may be here noted. The figures for *incandescent* lamps per capita are subject to possible correction, as discussed on page 77, but as shown in Table 43 the highest ratio is reached, apparently, in Indianapolis, of 1.533. None of the other cities come anywhere near this, the per capita being: For Boston, 0.910; San Francisco, 0.930; Providence, 0.906; Pittsburg, 0.871; New York city, 0.748; Detroit, 0.677; and St. Louis, 0.595. In Baltimore the per capita of incandescent lamps falls as low as 0.147. In Buffalo it is 0.226; in Minneapolis, 0.247; and in St. Paul, 0.295. In order to get a true idea of the real use per capita it would be necessary to include all lamps connected to isolated plants, which in some cities are very numerous. While Rochester is so abnormally high as to kilowatt hour output, it has a per capita of only 0.584, or slightly less than St. Louis, where the kilowatt output, on the other hand, was barely over 25 per cent of that of Rochester—an indication that a large proportion of current sold and earnings from operation in the latter place were due to motor service.

The per capita of *arc* lighting for all the cities runs with fair uniformity, and, as will be seen, the ratio falls off as they increase in size. Thus the per capita in Rochester of 0.032 at one end of the column decreases until it becomes 0.008 in New York at the other end of the column, although it falls slightly lower than that in Washington, namely, 0.007, and is closely approximated by Baltimore, where it is 0.009. In New York city, as in many of the large cities, a considerable proportion of the streets were and still are lighted by gas lamps, and in like manner a large proportion of the commercial lighting consists of incandescent lamps. The geographical location of the various cities would not appear to have much bearing upon the relative per capita under any of the heads, although none of the highest averages are reached by cities in the Southern and South Central divisions.

V.

EXPENSES.

General analysis of expenses.—The general figures of expense have already been noted in Section III of this chapter in connection with the general figures of income, Tables 14 and 15 giving the principal items and the percentages that they form of the total. The expenses of private and municipal stations reached a total of $68,081,375, of which $62,835,388, or 92.3 per cent, was for private stations and the remaining $5,245,987, or 7.7 per cent, for municipal stations. These expenses were classified into four main divisions, namely, salaries and wages, amounting to $20,646,692; cost of supplies, materials, and fuel, $22,915,932; rents, taxes, insurance, and miscellaneous expenses, $11,895,206; and interest on bonds, $12,623,545. Salaries and wages will be considered in Chapter IV, under "employees, salaries, and wages." The other items will be taken up and discussed in detail.

Cost of supplies and materials.—The central station expenses classified under the head of supplies, materials, and fuel, cover a wide field, including apparatus from which indefinitely long service may be expected, materials consumed from day to day, supplies that ultimately enter into construction and become permanent parts of the physical equipment, cost of purchased power, freight, and a number of other items. Tables 70 and 80 present analyses by states for private and municipal stations, respectively, showing the number and cost of meters, motors, transformers, incandescent lamps, carbons, arc lamp globes, and various other supplies purchased for use during the year. In gathering the statistics the actual cost of all supplies and materials exclusive of freight charges was requested, and the amount paid for freight, if any, was given as a separate item, but where it was not practicable to furnish this information separately the cost including freight charges was reported. The totals, therefore, are a combination of the central station reports in some of which the cost included freight while in others it did not, as a result of the different methods of bookkeeping in use in the various stations.

While it was the endeavor of the Bureau of the Census to eliminate from the cost of supplies and materials expenses for permanent additions to stations, such as new machinery, and for additions to the exterior equipment and lines on which new meters, motors, transformers, or lamps had been installed during the year, it is evident that in some cases a portion of supplies reported should have been charged as additions to the physical property of the station. Meters, motors, transformers, poles, wires, and cables have, under normal conditions, several years of life, and hence should be regarded as part of the central station investment represented by the capitalization, and as offsetting a certain amount of depreciation. Carbons, which are used from day to day, arc lamp globes, which are frequently smashed accidentally or maliciously, mill supplies needed daily in a power plant, and incandescent lamps requiring renewal once or twice a year, are items of consumption rather than of construction. On the other hand, some stations did an amount of mercantile business "over the counter" in the purchase and sale of incandescent lamps, arc lamps, carbons, etc., and although there is less tendency in this direction than there was in the early days of the industry, the greater extent of the field covered and the increased number of stations is likely to make such business considerable in the aggregate. It was, however, impossible to eliminate these items from the supplies used in operating

the system, or rather to distinguish the amount of profit over and above what the same material would have cost the station had the apparatus and supplies been used by the management rather than sold. The meters shown were required for measuring current on new circuits or were made necessary by the pronounced movement among central stations toward putting the sale of current on a scientific measuring basis in place of the old wasteful flat rate. Many of the motors enumerated would go directly into the central station equipment to serve in the operation of auxiliary mechanism. The transformers, like the meters, would be required for the extension of the lighting system.

Table 44 summarizes the totals for the cost of supplies and materials and shows the percentages which the amounts reported for the two classes of private and municipal stations were of the total. Although the table includes power purchased, it does not include the expense for fuel, this being treated as a separate subject.

TABLE 44.—*Cost of supplies and materials—private and municipal stations, and percentage each class is of total: 1902.*

	Total.	Private stations.	Municipal stations.	PER CENT— In private stations.	PER CENT— In municipal stations.
Total cost	$11,280,423	$10,303,956	$976,467	91.3	8.7
Meters:					
Number	27,632	25,739	1,893	93.1	6.9
Cost	$416,994	$390,569	$26,425	93.7	6.3
Motors:					
Number	602	572	30	95.0	5.0
Cost	$30,099	$29,202	$897	97.0	3.0
Transformers:					
Number	13,288	7,843	5,445	59.0	41.0
Cost	$365,028	$326,407	$38,621	89.4	10.6
Incandescent lamps:					
Number	8,839,905	8,399,571	440,334	95.0	5.0
Cost	$1,507,249	$1,426,224	$81,025	94.6	5.4
Incandescent lamp fittings, sockets, etc., cost	$177,236	$154,517	$22,719	87.2	12.8
Carbons for arc lamps:					
Number	94,686,596	82,156,930	12,529,666	86.8	13.2
Cost	$1,051,386	$900,788	$150,598	85.7	14.3
Globes for arc lamps:					
Number	485,073	428,979	56,094	88.4	11.6
Cost	$170,929	$150,509	$20,420	88.1	11.9
Arc lamp repairs, cost	$244,537	$212,231	$32,306	86.8	13.2
Poles or other supports, cost	$346,587	$319,617	$26,970	92.2	7.8
Wire and cable, cost	$1,152,915	$1,081,380	$71,535	93.8	6.2
Mill supplies (oil, waste, etc.), cost	$712,797	$617,911	$94,886	86.7	13.3
Power purchased, cost	$2,130,759	$2,007,193	$123,566	94.2	5.8
Freight paid, not included in other items	$1,120,363	$939,512	$180,851	83.9	16.1
All other materials, cost	$1,853,544	$1,747,896	$105,648	94.3	5.7

The total cost of all supplies and materials exclusive of fuel was $11,280,423; of this amount the stations under private ownership reported $10,303,956, or 91.3 per cent, and the stations under municipal control reported $976,467, or 8.7 per cent. The percentages in the subdivision of the apparatus varied considerably from these rates for reasons which can be readily understood in view of the different classes of business done. The work of the municipal plants is, as already noted, very largely arc street lighting, and hence the expenses for this class of supplies are proportionately high. For example, the expenses of municipal stations for arc carbons were $150,598, or 14.3 per cent of the total cost of such carbons, while the cost of globes for arc lamps was $20,420, or 11.9 per cent. The consumption of incandescent lamps fell to a low figure, the cost reported for municipal stations being $81,025, or only 5.4 per cent of the total. Somewhat strangely, however, the rate for incandescent lamp fittings was not less than 12.8 per cent, perhaps on account of street lighting, while the rate for transformers was 10.6 per cent. The purchase of the smaller types or sizes of transformers by municipal plants is strikingly brought out in the percentages of the number and the cost of such apparatus. Of the 13,288 reported, the municipal stations bought no fewer than 5,445, or 41 per cent and paid for them only $38,621, or 10.6 per cent. The small use of current for motor service in connection with municipal plants is again strikingly indicated by the fact that of the number of motors reported as bought the proportion was only 5 per cent, and the cost was only 3 per cent, of the total. Because of the nature of the service given, very few of the meters purchased were required by municipal plants, the number being only 6.9 per cent and the cost 6.3 per cent.

For the private stations reported in Table 44, out of a total of $10,303,956, the large amount of $2,007,193 was reported for power purchased, $1,426,224 for incandescent lamps, $900,788 for arc lighting carbons, $617,911 for mill supplies, $1,081,380 for wire and cable, and $939,512 for freight as a separate item, while miscellaneous materials were represented by the sum of $1,747,896.

It should be stated that the cost of hoods and miscellaneous supplies for arc lamps, amounting to $27,218, was included in the $1,853,544 reported as the cost of all other materials.

Cost of power purchased.—With respect to the large item of power purchased, it may be noted that a small number of central stations are engaged in the production of electric current for distribution to other stations, and are properly to be classed as distributing stations, although they also generate prime motive power to a limited extent for delivery without its conversion into electricity. The next report on electric light and power stations will undoubtedly include a large number of plants whose sole object is to generate current in large volume at waterpowers, coal mines, or oil fields, and transmit it long distances to distributing electric light plants or companies, which thus virtually will have become substations and will have ceased to manufacture current for themselves. Undoubtedly a number of such instances are included in this report, and hence the item of power purchased is larger than might reasonably have been expected. There were 136 stations thus reporting the purchase of electric current, costing $1,300,925. Another group of stations—71 in number—purchased waterpower costing $210,619, converting it themselves into current.

A third large group of 95 stations purchased steampower costing $296,831, and 1 station reported the purchase of power generated by gasoline engines at a cost of $240. There were 85 stations that rented the use of water for the operation of their water wheels, paying $322,144 for such hydraulic privileges, while the large aggregate sum of $460,011 was reported by a number of stations as paid for the water for generating steam in their boilers. Table 45 gives the percentage that the cost of each item of supplies and materials is of the total.

TABLE 45.—*Percentage that cost of each item of supplies and materials is of total—private and municipal stations: 1902.*

	Total.	Private stations.	Municipal stations.
Total	100.0	100.0	100.0
Meters	3.7	3.8	2.7
Motors	0.3	0.3	0.1
Transformers	3.2	3.2	4.0
Incandescent lamps	13.4	13.8	8.3
Incandescent lamp fittings, sockets, etc	1.6	1.5	2.3
Carbons for arc lamps	9.3	8.7	15.4
Globes for arc lamps	1.5	1.5	2.1
Arc lamp repairs	2.2	2.0	3.3
Poles or other supports	3.1	3.1	2.8
Wire and cable	10.2	10.5	7.3
Mill supplies (oil, waste, etc.)	6.3	6.0	9.7
Power purchased	18.9	19.5	12.7
Freight paid, not included in other items	9.9	9.1	18.5
All other materials	16.4	17.0	10.8

In private stations the cost of incandescent lamps formed 13.8 per cent of the total cost, and in municipal stations it was 8.3 per cent. On the other hand, the cost of carbons for arc lamps was 8.7 per cent in private stations and 15.4 in municipal stations. Power purchased in private stations reached the high proportion of 19.5 per cent, and was 12.7 per cent in municipal stations. Mill supplies in private stations were 6 per cent, and in municipal stations 9.7 per cent.

The analysis by states for these various items of supplies, materials, and power purchased does not call for particular comment. It is to be expected that a larger output would be attended by a larger consumption of material and supplies. The number and amounts follow closely the incomes from the sale of current reported for the respective states. New York figures as a large consumer in every class, followed by Pennsylvania, Massachusetts, Illinois, California, and Ohio.

Cost of fuel.—The item of fuel is a subdivision of one of the four main items of expense, namely, "cost of supplies, materials, and fuel," and constituted $11,635,509 out of the total of $22,915,932 included under that head. This total, however, is not the exact amount expended for coal and other fuel to be used in the generation of electric current, for an accurate separation of the expenditures was impossible. It has already been pointed out that the heading of supplies, materials, and fuel includes also power purchased at a cost of $2,130,759, of which steampower and gasoline power cost $297,071. This fuel account excludes also all allowance for current purchased by central stations for distribution, although much of that current was doubtless created by fuel consumption. As already shown in the tables presented, there were a large number of stations where both steam and water power were in use, and in these no attempt was made to charge up against the motive power plant the exact amount of current generated, so that the tables do not disclose for such plants how large a proportion of kilowatt hours was produced with the aid of steam and how large a proportion by means of waterpower. For these reasons a determination of the exact cost of fuel as related to the output would be very difficult.

Tables 70 and 80 present detailed statistics, by states and territories, for the different varieties of fuel reported by private and municipal stations, respectively.

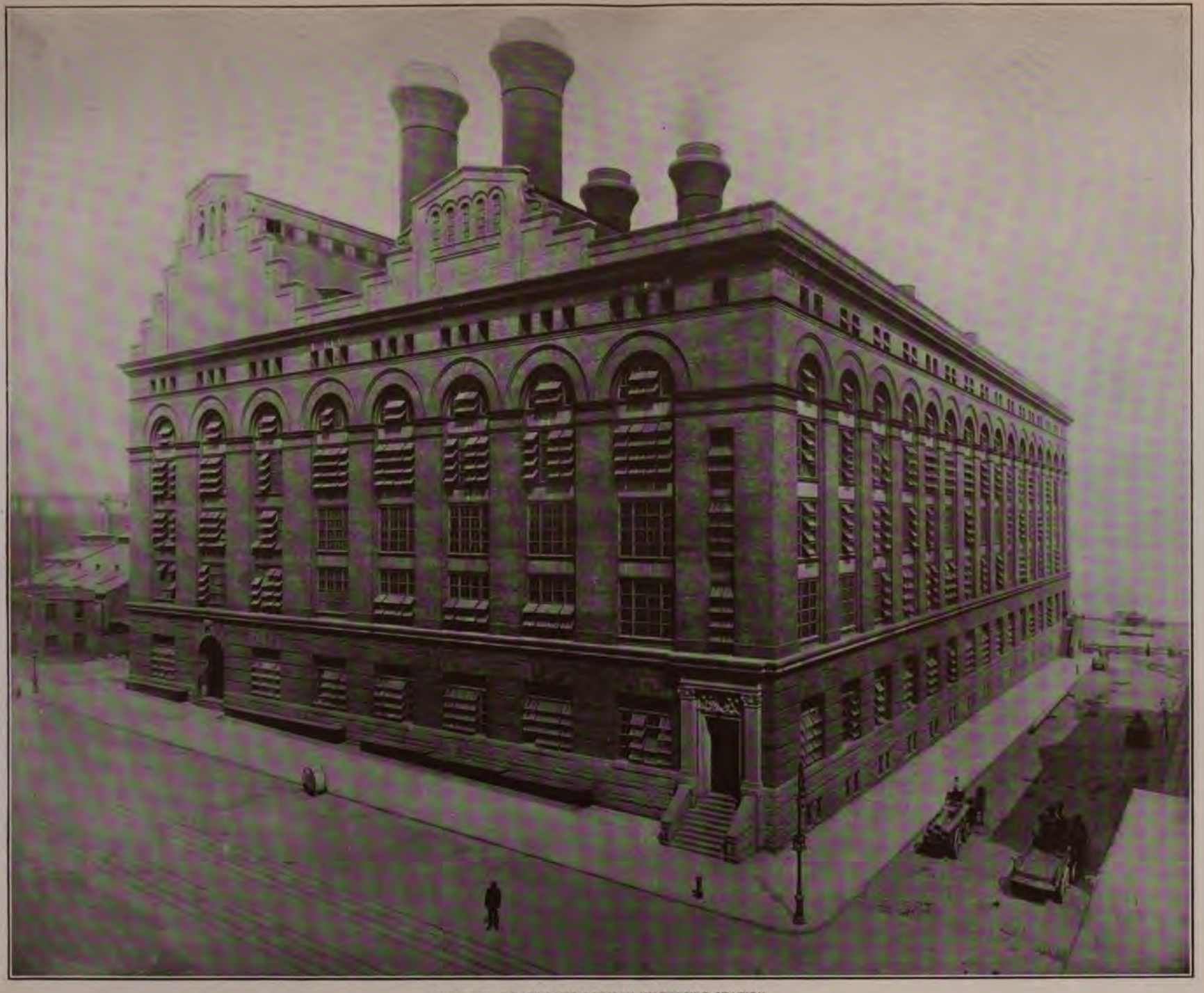
The totals are given in Table 46, which shows the percentage that the cost of the various kinds of fuel consumed in each class of stations forms of the totals for both classes.

TABLE 46.—*Cost of fuel—private and municipal stations, and percentage each class is of total: 1902.*

	Total.	PRIVATE STATIONS.		MUNICIPAL STATIONS.	
		Amount.	Per cent.	Amount.	Per cent.
Total	$11,635,509	$10,189,685	87.6	$1,445,824	12.4
Coal	9,943,125	8,749,394	88.0	1,193,731	12.0
Crude petroleum	721,838	700,136	97.0	21,702	3.0
Natural gas	254,269	220,460	86.7	33,809	13.3
Artificial gas	28,654	20,135	70.3	8,519	29.7
All other fuel	687,623	499,560	72.7	188,063	27.3

Coal was the fuel in most general use, its cost being $9,943,125, or 85.5 per cent of the total reported cost of fuel. All other fuels together amounted to 14.5 per cent. Next to coal, crude petroleum was the most important variety of fuel, its cost amounting to $721,838. In private stations the cost of this fuel formed 6.9 per cent of the total cost of all fuel purchased by those stations. Natural gas cost $254,269 and artificial gas $28,654. The large sum of $687,623 was expended for all other fuels, which would include a large amount of wood and lumber refuse as well as other waste materials.

The total amount of coal purchased was 4,249,137 tons at a cost of $8,749,394 for private stations, and 568,460 tons at a cost of $1,193,731 for municipal stations, the rates being $2.06 per ton for private stations and 4 cents more per ton for municipal stations. The difference in favor of private stations was undoubtedly due to the much larger quantities in which such fuel was purchased. The analysis by states naturally shows considerable variation in the cost of coal. This is due to the location of stations in states where coal is cheap and plentiful or their remoteness from the sources of supply; to the action of municipalities which in some cases forbid the use of the cheaper, more voluminous grades; to the fact that some stations use inferior grades, slack coal being purchased at a price as low as 60 cents a ton in Kansas; and to the different practices



EXTERIOR OF NEW YORK EDISON WATERSIDE STATION.

prevailing which result in some stations including freight in the cost while others do not. It will be seen, for example, that in California, where coal is scarce, 5,752 tons cost $28,365, or $4.93 per ton; but this amount probably includes the freight, as very little freight is reported for the state. The high price of coal would explain to some extent not only the enormous waterpower development in the state but also the fact that out of the total $700,136 expended in the country for crude petroleum for use under boilers in private central stations, $502,153 was reported in that state. The cost of coal is not always a determining factor where petroleum is concerned, for in the state of Texas, where coal costs about $1.63 per ton, its total cost was $170,691, while the expenditure for crude petroleum was not much less, being $124,365. In this state, however, the freight on coal was evidently reported separately, the report showing more freight paid in Texas than in any other state. Massachusetts is a state in which electric light and power has enjoyed remarkable development, but the prices of fuel there are seriously high. The 203,456 tons of coal necessary for the private stations were purchased at a cost of $808,361, or almost $4 per ton, but this again included the freight. In Illinois more than twice as much coal was purchased for a less amount, but here the freight was reported separately. In this state there was at one time a considerable consumption of natural gas for generating electric current, and crude petroleum also was extensively used for a time. In the census year, however, the expenditure for these fuels had dwindled to the insignificant amounts of $574 for petroleum and $3,473 for natural gas. With regard to the last-named fuel, Pennsylvania and Indiana furnished the largest items. The total for natural gas was $128,918 in Pennsylvania, $45,414 in Indiana, and $26,725 in Ohio. These three states accounted for $201,057 out of a total of $220,460. The low total for the whole country seems to be evidence of the diminishing importance of the natural gas fields, so far as the utility of gas for central stations is concerned.

As for crude petroleum, it will be noted that for the census year the consumption for private stations was limited almost entirely to two centers of production, California and Texas accounting for all but $73,618 out of a total of $700,136. A large amount, namely, $50,600, was reported from Arizona, and $15,866 from Louisiana. Only $204 was reported from Pennsylvania, but the quality of the petroleum produced in that state is such that it is used for illuminating purposes rather than for fuel.

Miscellaneous expenses.—Tables 72 and 82 present statistics for the principal items of miscellaneous expenses for the private and municipal stations, respectively, by states and territories. The totals are summarized in Table 47, which also shows the percentages that the amounts reported for private and municipal stations, respectively, are of the total.

TABLE 47.—*Miscellaneous expenses—private and municipal stations, and percentage each class is of total: 1902.*

	Total.	PRIVATE STATIONS.		MUNICIPAL STATIONS.	
		Amount.	Per cent.	Amount.	Per cent.
Total expenses	$11,895,206	$11,456,037	96.3	$439,169	3.7
Rent of stations, line wire supports and conduits, or underground privileges	1,011,691	1,001,504	99.0	10,187	1.0
Rent of offices	275,007	270,446	98.3	4,561	1.7
Taxes	2,665,005	2,654,885	99.6	10,120	0.4
Injuries and damages	248,304	246,545	99.3	1,759	0.7
Insurance	893,567	827,926	92.7	65,641	7.3
Ordinary repairs of buildings and machinery	2,701,747	2,480,217	91.8	221,530	8.2
Interest, advertising, office supplies, law expenses, telephone and telegraph service, and sundries	4,099,885	3,974,514	96.9	125,371	3.1

It will be seen that for all of the stations, rent, taxes, expenditure on account of injuries and damages, insurance, and cost of ordinary repairs account for $7,795,321, leaving the large amount of $4,099,885 for interest, law expenses, cost of advertising, office supplies, telephone and telegraph service, and sundries. This heterogeneous group constituted 34.5 per cent of all the miscellaneous expenses, while cost of repairs of buildings and machinery constituted only 22.7 per cent, and taxes 22.4 per cent. Of the total amount paid the private stations reported 96.3 per cent and the municipal stations only 3.7 per cent. The rent of stations, line wire supports, and conduits for municipal stations was only 1 per cent of the total cost of these items, and rent of offices was only 1.7 per cent of the total expended for office rent. In many instances the use of subways costs the municipalities nothing. The reservation, free of cost, of a certain number of ducts, as well as a certain pin or cross-arm capacity of pole line, is frequently part of the consideration for which certain ordinances or privileges are granted. The offices of the municipal departments are usually in some building that belongs to the municipality, and hence it rarely happens that a municipality has to pay rent to any large extent. Again, taxes for municipal stations fell to the low proportion of four-tenths of 1 per cent, from which it would appear that in few instances do the municipalities charge against themselves the entire amount of taxes that would have to be paid by stations under private ownership. The proportion paid for injuries and damages is also strikingly small for the municipal stations, being only seven-tenths of 1 per cent. The items of insurance and repairs for municipal plants are more nearly at the normal, being, respectively, 7.3 and 8.2 per cent. The amount reported for the group, including interest, etc., is only a small proportion of the whole—namely, 3.1 per cent. This is not surprising, however, because if there is any advertising account for a municipal station it is exceedingly small, while the interest on the floating debt is very small also, and telephone and telegraph service is often rendered free for ordinance considerations.

CHAPTER IV.

EMPLOYEES, SALARIES, AND WAGES.

Tables 71 and 81 show, by states and territories, the number of salaried officials and clerks and the total amount of salaries paid each class during the year, also the average number and total wages of the different classes of wage-earners in private and municipal stations, respectively. In accordance with the practice adopted for the investigation of manufactures,[1] the Bureau of the Census endeavored to secure the average number employed during the year because it would be the best indication of the force required to operate the stations continuously. In cases where a general account was kept covering two or more different services, such as the operation of waterworks or the manufacture of gas in addition to the production of electricity, and one employee, such as general manager, clerk, engineer, or fireman, worked indiscriminately for the different branches of the service, an estimate was made of the time and salary properly chargeable to the electric station, and only this proportion is included in the report.

I.

SALARIED OFFICIALS AND CLERKS.

General statistics.—There were 6,996 salaried officials and clerks employed by the central electric stations, and they were paid $5,663,580 in salaries. Of this number 43.1 per cent were clerks, who received 30.3 per cent of the total salaries. The stations operated under private ownership employed 86.4 per cent of the total number of officials and clerks, and those under municipal control 13.6 per cent. The salaries paid in the private stations amounted to 91.9 per cent, while those in the municipal stations amounted to 8.1 per cent of the total. The stations operated under private ownership gave employment to 91.3 per cent of the total number of clerks and paid 96.2 per cent of the total salaries paid to clerks as compared with 8.7 and 3.8 per cent, respectively, for municipal stations.

Statistics for private stations.—Of the 6,046 salaried officials and clerks reported by private stations, 1,416 were returned as general officers and 1,875 as other officers, such as managers and superintendents, and 2,755 as clerks. The total salaries paid to general officers was $1,465,471, to other officers $2,088,298, and the amount paid to clerks was $1,652,430. The rank of the states as to the number of salaried employees and their pay follows closely the rank as to earnings, and to some extent the rank as to the number of stations. Thus New York, with 228 stations and a gross income of $16,631,802, had 869 salaried employees to whom was paid $801,844; in Pennsylvania, with 243 stations and a gross income of $9,057,503, there were 667 employees with salaries amounting to $511,580; in Massachusetts, with 97 stations and a gross income of $6,070,643, the 420 salaried officials and clerks were paid $448,221; and in Illinois, with 264 stations and a gross income of $5,578,012, the number was 525, and the salaries amounted to $444,702. These larger totals show from two to four salaried employees per plant, a relation which exists also in several other states—for example, California, Missouri, New Jersey, and Ohio. But in many states the average number per plant was less. Thus in Arkansas, for 34 stations only 30 salaried officers and clerks were reported. In Florida 22 were employed for 21 stations; in Indian Territory, 7 for 10 stations; in Mississippi, 29 for 25 stations; in Nevada, 7 for 5 stations; in New Mexico, 12 for 11 stations; in North Dakota, 15 for 13 stations; in Oklahoma, 12 for 8 stations; in South Dakota, 18 for 22 stations; and in Wyoming, 13 for 13 stations. It will be readily seen that the average station in these states was not large enough to employ more than one man to look after the books and accounts, it being necessary for the one employee to divide his time in a manner that would enable the small station to operate most economically as to its expense for salary. As a matter of fact, however, many stations had no employees of this character, the work being done by the foremen or proprietors. Presumably the grade of salary would follow the industrial conditions of the section or community in which the station is located, but it would be governed also by the amount of work required.

If these figures be further analyzed it will be observed that both the general officers and the other officers were on a lower basis of compensation as compared with the clerks, although the combined executive and technical management of the station, as distinguished from the administration of officers, would appear to enjoy higher remuneration—a reasonable state of affairs wherever the responsibility for the technical operation of the station rested upon one man. These facts would be clearer if the difference between "general" officers and "managing" officers were more marked, but without going into very minute detail, it would be impossible to

[1] Twelfth Census, Vol. VII, page cvi.

extract and collate data with regard to all the actual conditions. In Oregon 5 general officers were paid $19,400, while 20 other officers were paid only $24,180. On the other hand, in Virginia, 18 general officers were paid $6,471, while 15 other officers were paid $8,674. In Idaho 4 general officers were paid $2,580, or $645 each, while 11 other officers were paid $13,520. Taking a larger state it will be seen that in New York 192 general officers were paid $261,465, while the other officers, 186 in number, were paid $237,106. In Pennsylvania, on the other hand, while 186 general officers were paid $118,564, or $637 each, 212 other officers were paid $233,140. Since in the number of stations New York and Pennsylvania did not differ much, the inference is that in Pennsylvania less of executive management was thrown upon the general officers, their duties being more purely financial, while the responsibility upon the manager and superintendent was heavier, and was accompanied by a correspondingly high salary. The subject is, however, a complicated one. The trained and educated electrical engineers devoting themselves to the central station industry professionally would be found very generally distributed throughout both groups of managers, and the extent to which the technical operation of the station would be preferred to the more general executive control of the enterprise, as a whole, would depend in almost every case upon personal predilection or idiosyncrasy.

Statistics for municipal stations.—As presented in Table 81, dealing with municipal stations, the number of salaried officers and clerks was 950, and their salaries amounted to $457,381. There were 171 general officers with salaries amounting to $36,051, 518 other officers with salaries amounting to $356,929, and 261 clerks with salaries amounting to $64,401. It will be seen that very few of the stations had general officers, and that even if the other officers were added to the general officers there would not be an average of one officer per plant. This is a striking indication of the economical basis upon which the stations were conducted, and the general absence from them of skill and training of high grade. This is partly due to the fact that such stations are frequently operated under a board of unpaid officials, virtually a committee of the local council or board of aldermen, and in some cases the salary reported was merely an estimated pro rata of that paid for the supervision of more than one service. This fact is more clearly illustrated by the much higher salaries paid to the other officers, managers, and superintendents. It is obvious, however, that the inducements presented to the mechanical or electrical engineer by the opportunities in the municipal electric lighting field, from the standpoint of salary, were far below those in the private field, unless the municipal officer could supplement his income quite substantially by the performance of kindred services for the community, or could do work outside his regular employment. Of course, there were some stations with salaries greater than the figure cited; for example, in Louisiana 6 general officers were paid $5,680. The few high salaries were offset by some very low figures; in Missouri, 3 general officers were paid $150; in Tennessee, 9 were paid $486; and in Wisconsin 3 were paid $225. In these and other instances the amount paid should probably be regarded as an honorarium rather than a salary. In like manner, in Illinois, 38 miscellaneous officers were paid $31,009; in Mississippi 9 were paid $8,668, while the rates for the solitary managers in Maine, Rhode Island, Montana, and Utah were, respectively, $832, $840, $900, and $960.

II.

WAGE-EARNERS.

General statistics.—Table 48 summarizes the totals for the average number and the wages of wage-earners reported for both private and municipal stations and shows the proportion in each class of station.

TABLE 48.—*Average number of wage-earners and total wages—private and municipal stations, and percentage each class is of total: 1902.*

OCCUPATION.	Total.	Private stations.	Municipal stations.	PER CENT— In private stations.	PER CENT— In municipal stations.
Total:					
Average number	23,330	20,863	2,467	89.4	10.6
Wages	$14,983,112	$13,560,771	$1,422,341	90.5	9.5
Foremen—					
Average number	1,000	943	57	94.3	5.7
Wages	$953,738	$910,972	$42,766	95.5	4.5
Inspectors—					
Average number	571	546	25	95.6	4.4
Wages	$415,904	$397,983	$17,921	95.7	4.3
Engineers—					
Average number	4,587	3,743	844	81.6	18.4
Wages	$3,259,870	$2,721,127	$538,743	83.5	16.5
Firemen—					
Average number	3,456	2,951	505	85.4	14.6
Wages	$1,963,465	$1,717,149	$246,316	87.5	12.5
Dynamo and switchboard men—					
Average number	1,978	1,872	106	94.6	5.4
Wages	$1,351,676	$1,286,065	$65,611	95.1	4.9
Linemen—					
Average number	4,217	3,868	349	91.7	8.3
Wages	$2,710,841	$2,510,269	$200,572	92.6	7.4
Mechanics—					
Average number	1,057	1,009	48	95.5	4.5
Wages	$796,355	$768,694	$27,661	96.5	3.5
Lamp trimmers—					
Average number	2,637	2,318	319	87.9	12.1
Wages	$1,654,462	$1,460,046	$194,416	88.2	11.8
All other employees—					
Average number	3,827	3,613	214	94.4	5.6
Wages	$1,876,801	$1,788,466	$88,335	95.3	4.7

The average number of wage-earners in central stations was 23,330, and the amount paid in wages was $14,983,112. Of these wage-earners 20,863, or 89.4 per cent, were employed in private stations, and 2,467, or 10.6 per cent, were employed in municipal stations. To those in the private stations were paid wages amounting to $13,560,771, or 90.5 per cent of the total, and to those in municipal stations $1,422,341, or 9.5 per cent.

Classification of wage-earners according to occupation.—These wage-earners were divided into eight main classes and one miscellaneous class. The eight chief

groups include foremen, inspectors, engineers, firemen, dynamo and switchboard men, linemen, mechanics, and lamp trimmers, while the miscellaneous class includes a large proportion of unskilled labor.

The equipment, size of station, and character of the service control very largely the proportion that the different classes of wage-earners are of the total. For instance, an engineer may act as the fireman or possibly as the foreman of a small station, while in a large station the positions would be filled by separate employees. Small stations do not necessarily require inspectors, and the linework may be done by the general mechanics. In the same manner the duties of the linemen and the lamp trimmer may be combined in one person in small stations, while larger stations require separate employees for these positions; therefore, it is not always possible to make an accurate segregation of the employees according to occupation. With this explanation the following table is presented to show the proportion that the number of wage-earners reported for each of the 8 classes, is of the total for all stations and for private and municipal stations, respectively:

TABLE 49.—*Percentage that number of wage-earners reported for each occupation is of total—private and municipal stations: 1902.*

OCCUPATION.	Total.	Private stations.	Municipal stations.
All classes	100.0	100.0	100.0
Foremen	5.1	5.5	2.5
Inspectors	3.0	3.2	1.1
Engineers	23.5	21.7	37.5
Firemen	17.7	17.1	22.4
Dynamo and switchboard men	10.2	10.9	4.7
Linemen	21.6	22.4	16.5
Mechanics	5.4	5.8	2.1
Lamp trimmers	13.5	13.4	14.2

Accepting the totals for each occupation as the number required to discharge the duties in each case, the table shows to what extent the principal occupations, such as linemen, engineers, and firemen, predominate; also the variation in the proportion reported for each occupation in the two classes of stations. The greatest variation appears for engineers, who formed 21.6 per cent of all wage-earners in private stations and 37.3 per cent of all those in municipal stations. The predominance of engineers and firemen is more pronounced in the municipal stations, while the proportion for each of the other occupations, except lamp trimmers, is larger in the private stations.

It is probable that the duties of engineers, firemen, and dynamo and switchboard men are as intimately related as those of any of the occupations enumerated, and the relation between the numbers reported for the stations operated under private and municipal control is indicative of the extent to which separate employees were required for the different branches of work. In the private stations 1 fireman was required for every 1.3 engineers and 1 dynamo and switchboard man for every 2.3 engineers, while in the municipal stations the proportions were 1 to 1.7 and 1 to 8, respectively. In other words, the totals for all stations, large and small, indicate that in the municipal stations the engineers were more accustomed to perform a greater diversity of the duties incident to the operations of the power and generating plant than they were in the stations operated under private ownership. Continuing this comparison, it appears that in the private stations 1 foreman is required for every 17.3 of all other employees of the classes enumerated, and in the municipal stations the proportion is 1 to 38.5; but the great difference in these proportions can probably be accounted for by the fact that the supervision of a municipal station is frequently assigned to a public official who has other duties to perform, and the time devoted to the electric station is so limited that he is not considered as one of its employees, or the engineer may discharge the duties that would be assigned to a foreman in a station operated for private interests.

Statistics for private stations.—In Table 71 the wage-earners are presented, by states and territories, for the private stations. By far the largest number of wage-earners in private stations was found in New York, where 4,427 were employed, earning $3,035,971. Next came Pennsylvania, with 2,327, earning $1,468,472; Massachusetts, with 1,474, earning $1,053,344; Illinois, with 1,400, earning $871,165; Ohio, with 1,026, earning $636,515; and California, with 976, earning $758,678. The number of wage-earners per station averaged over 19 in New York as compared with not quite 10 in Pennsylvania, 15 in Massachusetts, 5 in Illinois, 7 in Ohio, and 9 in California.

The foremen were somewhat more generally distributed than the inspectors, there being 943 foremen and only 546 inspectors. Engineers numbered 3,743, or more than 1 per station. Their numbers generally followed the respective magnitude of stations and the extent to which the industry had been developed, but depended somewhat on the prevalence of the use of waterpower. In New York the number of engineers employed was 451 for the 228 stations as compared with 471 for the 243 stations in Pennsylvania. In Illinois there were 377 engineers in 264 stations and in California only 94 in 105 stations. In New York, California, and some other states, the extent to which waterpower was utilized obviously had an influence in determining the number of both the engineers and the firemen as related to the number of dynamo and switchboard men. Thus, regardless of the small number of

engineers and firemen, there were in California 194 dynamo and switchboard men, which was a more uniform ratio and a number in closer harmony with the figures for other states, where waterpower was not so generally used. The engineers and firemen in smaller stations were evidently employed upon the same class of work, as this table shows that where the number of engineers is relatively low the number of firemen is equally high and vice versa. It is to be noted that no firemen were employed in Nevada and that that state was also without linemen and mechanics, the duty of such employees being discharged by others. In like manner the stations in Indian Territory, New Mexico, North Dakota, and Oklahoma reported no dynamo tenders or switchboard men, the inference being that some of these unavoidable duties were performed by the lamp trimmers.

For the private stations in the United States there were reported 2,318 lamp trimmers and 334,903 arc lamps, the average being 144 lamps to each lamp trimmer. The introduction of the inclosed arcs, which require trimming only at intervals of several days, would lessen the amount of work here indicated, and the number of lamps per trimmer would be further reduced by the extent to which the work would be shared by linemen, of whom 3,868 were returned. Some of the lamp trimming also, as well as the other duties ascribed to the men in the various categories enumerated, would be performed by the "all other employees," numbered at 3,613. But this class would include a large number of minor wage-earners engaged in unskilled labor rather than in the skilled work necessary for the operation of an electric light plant. It will be noticed that in New York the number of lamp trimmers was 616 as compared with 708 linemen, while in Pennsylvania there were only 267 lamp trimmers as compared with 522 linemen; in Illinois, 179 as compared with 238; and in Massachusetts 145 as compared with 247.

In Pennsylvania only 224, or about 10 per cent, of the wage-earners were reported as in the group of "all other employees," but in New York 1,055, or over 23 per cent, and in Massachusetts 447, or 30 per cent, were thus classified. Large numbers in this group would indicate a wider variety of occupations than is possible in many of the smaller stations, where employees are almost entirely accounted for under the main classifications and distinctions given.

Statistics for municipal stations.—In Table 81 the wage-earners in municipal stations are subject to the same classifications as those in private stations, but show a much more general merging of functions as a result of the relatively lesser magnitude of the stations.

Of the 2,467 wage-earners in municipal stations, 359 were in Illinois, 290 in Michigan, 275 in Ohio, 172 in Indiana, 140 in Pennsylvania, and 127 in Minnesota. The average number of wage-earners for the municipal stations was about 3; in Florida, Washington, Texas, and Massachusetts the average was 5 or more; and in Oregon there were only 5 wage-earners to 6 stations. A cursory examination of the table will show from the numerous gaps how generally the various duties are concentrated in one person, rendering it difficult to make an exact classification under each head. Some of the municipal stations were without engineers and firemen, although this would be explained by the absence of steam engines and the use of waterpower, but in several states no dynamo or switchboard men were accounted for, no linemen, no mechanics, and no lamp trimmers.

III.

DAILY WAGES.

Specified daily rates of pay.—In addition to requiring the average number of wage-earners and the total amount of wages, the schedules called for the number of the different classes of wage-earners at specified daily rates of pay. In a number of cases, where the work of the central electric station was carried on in connection with some other industry, it was impossible to obtain satisfactory answers to this inquiry, but the returns for 3,197 stations were sufficiently complete for tabulation. For these stations Table 50 shows for all the wage-earners, except those classified as "all other employees" and for the leading classes separately the number receiving stated daily rates of wages within 25-cent limits. It shows also the percentage that the number falling within each wage group bears to the total number of wage-earners of the class, together with cumulative percentages.

TABLE 50.—NUMBER OF WAGE-EARNERS AT SPECIFIED DAILY RATES OF PAY, WITH PERCENTAGES OF TOTAL AND CUMULATIVE PERCENTAGES—PRIVATE AND MUNICIPAL STATIONS: 1902.

[Each cumulative percentage shows the proportion of total number of persons in the given class receiving a wage as great as, or greater than, the lowest wage of the given wage group.]

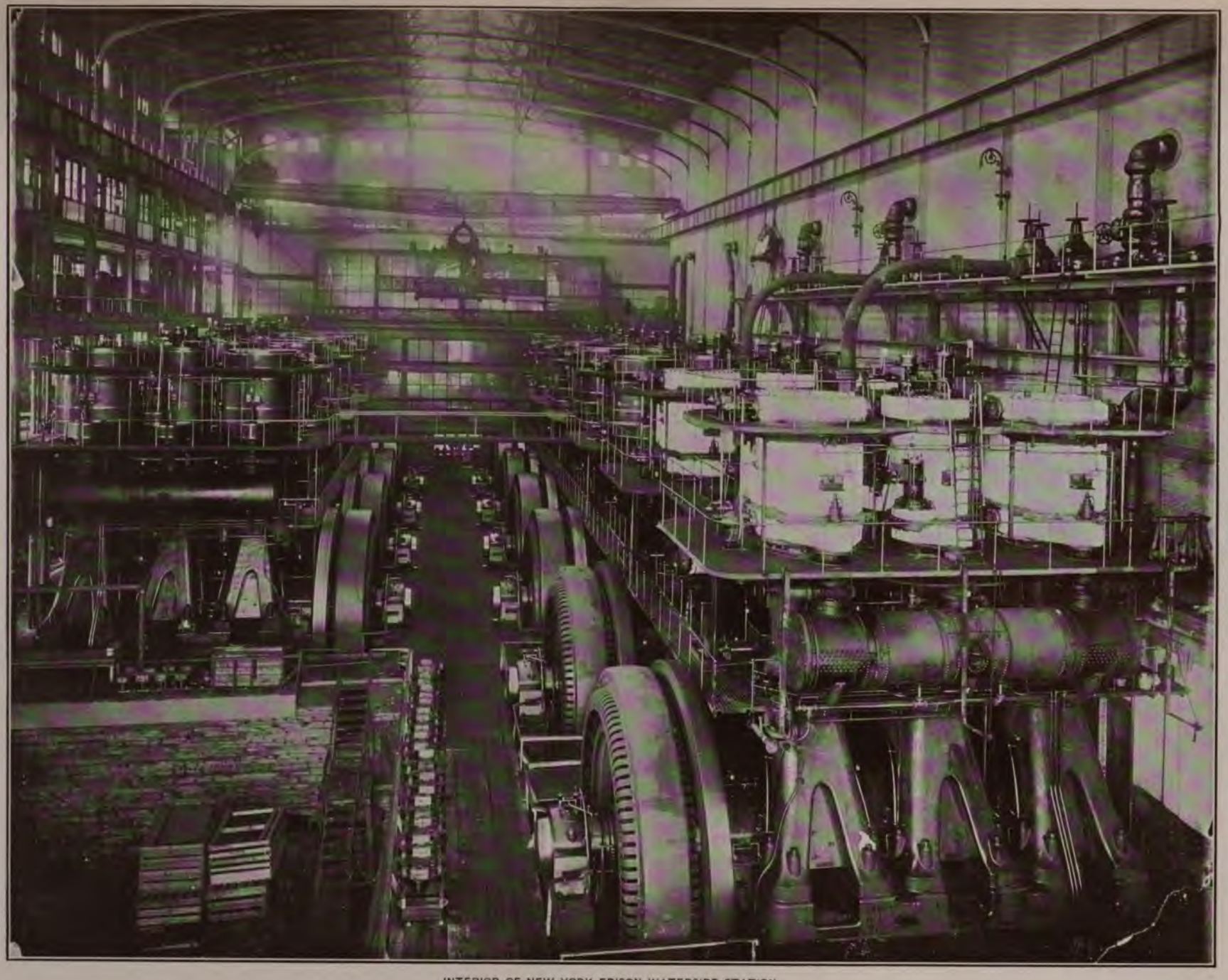
RATE PER DAY (DOLLARS).	ALL CLASSES.			FOREMEN.			INSPECTORS.			ENGINEERS.		
	Number.	Per cent.		Number.	Per cent.		Number.	Per cent.		Number.	Per cent.	
		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.
Total	18,878	100.0	.....	958	100.0	.....	557	100.0	.....	4,409	100.0	.....
Less than 1.00	362	1.9	100.0	2	0.2	100.0	15	2.7	100.0	42	1.0	100.0
1.00 to 1.24	990	5.2	98.1	7	0.7	99.8	13	2.3	97.3	211	4.8	99.0
1.25 to 1.49	1,613	8.5	92.9	17	1.8	99.1	31	5.6	95.0	469	10.7	94.2
1.50 to 1.74	3,380	17.9	84.4	59	6.2	97.3	50	9.0	89.4	825	18.7	83.5
1.75 to 1.99	2,314	12.3	66.5	34	3.6	91.1	70	12.6	80.4	438	9.9	64.8
2.00 to 2.24	4,089	21.7	54.2	94	9.8	87.5	141	25.3	67.8	892	20.2	54.9
2.25 to 2.49	1,807	9.6	32.5	82	8.6	77.7	67	12.0	42.5	351	8.0	34.7
2.50 to 2.74	1,899	10.1	22.9	132	13.8	69.1	87	15.6	30.5	472	10.7	26.7
2.75 to 2.99	823	4.4	12.8	77	8.0	55.3	19	3.4	14.9	181	4.1	16.0
3.00 to 3.24	832	4.4	8.4	163	17.0	47.3	34	6.1	11.5	226	5.1	11.9
3.25 to 3.49	309	1.6	4.0	116	12.1	30.3	10	1.8	5.4	115	2.6	6.8
3.50 to 3.74	191	1.0	2.4	76	7.9	18.2	9	1.6	3.6	58	1.3	4.2
3.75 and over	269	1.4	1.4	99	10.3	10.3	11	2.0	2.0	129	2.9	2.9

RATE PER DAY (DOLLARS).	FIREMEN.			DYNAMO AND SWITCHBOARD MEN.			LINEMEN.			MECHANICS.			LAMP TRIMMERS.		
	Number.	Per cent.		Number.	Per cent.		Number.	Per cent.		Number.	Per cent.		Number.	Per cent.	
		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.
Total	3,340	100.0	.....	1,888	100.0	.....	4,099	100.0	.....	1,039	100.0	.....	2,588	100.0	.....
Less than 1.00	150	4.5	100.0	22	1.2	100.0	57	1.4	100.0	9	0.9	100.0	65	2.5	100.0
1.00 to 1.24	334	10.0	95.5	105	5.6	98.8	179	4.4	98.6	7	0.7	99.1	134	5.2	97.5
1.25 to 1.49	472	14.1	85.5	138	7.3	93.2	265	6.4	94.2	19	1.8	98.4	202	7.8	92.3
1.50 to 1.74	740	22.2	71.4	348	18.4	85.9	686	16.7	87.8	107	10.3	96.6	565	21.8	84.5
1.75 to 1.99	472	14.1	49.2	263	13.9	67.5	520	12.7	71.1	164	15.8	86.3	353	13.7	62.7
2.00 to 2.24	587	17.6	35.1	423	22.4	53.6	835	20.4	58.4	276	26.6	70.5	841	32.5	49.0
2.25 to 2.49	295	8.8	17.5	264	14.0	31.2	331	8.1	38.0	101	9.7	43.9	316	12.2	16.5
2.50 to 2.74	128	3.8	8.7	180	9.5	17.2	668	16.3	29.9	161	15.5	34.2	71	2.8	4.3
2.75 to 2.99	122	3.6	4.9	56	3.0	7.7	278	6.8	13.6	71	6.8	18.7	19	0.7	1.5
3.00 to 3.24	33	1.0	1.3	56	3.0	4.7	225	5.5	6.8	85	8.2	11.9	10	0.4	0.8
3.25 to 3.49	3	0.1	0.3	20	1.0	1.7	25	0.6	1.3	14	1.3	3.7	6	0.2	0.4
3.50 to 3.74	2	0.1	0.2	4	0.2	0.7	23	0.5	0.7	13	1.3	2.4	6	0.2	0.2
3.75 and over	2	0.1	0.1	9	0.5	0.5	7	0.2	0.2	12	1.1	1.1	.....	.....	.....

In addition to the 8 classes of wage-earners shown in the table, other wage-earners were reported as engaged in a variety of occupations, too numerous to designate at specified rates of pay, and they were, therefore, omitted from this table, although they were included in Tables 71 and 81 under the group of "all other employees." This table, therefore, shows for the 8 classes of wage-earners in the 3,197 stations operated under private and municipal ownership, for which the employees are summarized by occupations at stated daily rates of pay, 18,878 wage-earners, or 80.9 per cent of the total number for all stations in operation during the year covered by this report. The distribution of this large number of employees among the different daily rates of pay indicates very closely the prevailing rates of wages in the industry. For all classes taken together the prevailing rate of wages was from $1.50 to $2.24 per day, 9,783 wage-earners, or 51.8 per cent of the total number shown in the table, being paid at this rate. It appears that 13,489 wage-earners, or more than two-thirds of the total number, received from $1.50 to $2.74 per day. More than one-half of the engineers received from $1.50 to $2.49 per day, and more than one-half of the firemen received from $1.50 to $2.24 per day.

The cumulative percentages in the table indicate the proportion of the total number of wage-earners of the different occupations who received not less than the lowest rate of the given wage group. Thus, for all wage-earners combined, the cumulative percentage opposite the group of $1.75 to $1.99 per day indicates that 66.5 per cent of the total number received $1.75 or more per day. The percentage of total opposite the same wage group indicates that 12.3 per cent of all wage-earners received between $1.75 and $1.99, thus leaving 54.2 per cent who received more than $1.99, which is the cumulative percentage for the next higher wage group.

All but 330 of the 2,805 stations operated under private ownership, and all but 93 of the 815 stations operated under municipal control, gave satisfactory replies to the inquiry concerning the number of employees at stated daily rates of pay, and the results are shown in the following tables:



INTERIOR OF NEW YORK EDISON WATERSIDE STATION.

This plant exemplifies on a large scale the largest development of direct connected dynamos and engines as separate mechanism, the engines being of the reciprocating type.

TABLE 51.—NUMBER OF WAGE-EARNERS AT SPECIFIED DAILY RATES OF PAY, WITH PERCENTAGES OF TOTAL AND CUMULATIVE PERCENTAGES—PRIVATE STATIONS: 1902.

[Each cumulative percentage shows the proportion of total number of persons in the given class receiving a wage as great as, or greater than, the lowest wage of the given wage group.]

RATE PER DAY (DOLLARS).	ALL CLASSES.			FOREMEN.			INSPECTORS.			ENGINEERS.		
	Number.	Per cent.		Number.	Per cent.		Number.	Per cent.		Number.	Per cent.	
		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.
Total	16,721	100.0	.....	908	100.0	.....	533	100.0	.....	3,604	100.0	.....
Less than 1.00	257	1.5	100.0	2	0.2	100.0	14	2.6	100.0	34	1.0	100.0
1.00 to 1.24	789	4.7	98.5	6	0.7	99.8	13	2.4	97.4	152	4.2	99.0
1.25 to 1.49	1,319	7.9	93.8	13	1.4	99.1	31	5.8	95.0	365	10.1	94.8
1.50 to 1.74	2,940	17.6	85.9	52	5.7	97.7	50	9.4	89.2	657	18.2	84.7
1.75 to 1.99	2,081	12.4	68.3	33	3.6	92.0	66	12.4	79.8	354	9.8	66.5
2.00 to 2.24	3,671	21.9	55.9	89	9.8	88.4	134	25.1	67.4	724	20.1	56.7
2.25 to 2.49	1,604	9.6	34.0	75	8.3	78.6	62	11.6	42.3	286	8.0	36.6
2.50 to 2.74	1,733	10.4	24.4	120	13.2	70.3	82	15.4	30.7	382	10.6	28.6
2.75 to 2.99	794	4.8	14.0	74	8.2	57.1	19	3.6	15.3	166	4.6	18.0
3.00 to 3.24	798	4.8	9.2	158	17.4	48.9	33	6.2	11.7	203	5.6	13.4
3.25 to 3.49	284	1.7	4.4	113	12.4	31.5	10	1.9	5.5	97	2.7	7.8
3.50 to 3.74	189	1.1	2.7	76	8.4	19.1	9	1.7	3.6	58	1.6	5.1
3.75 and over	262	1.6	1.6	97	10.7	10.7	10	1.9	1.9	126	3.5	3.5

RATE PER DAY (DOLLARS).	FIREMEN.			DYNAMO AND SWITCHBOARD MEN.			LINEMEN.			MECHANICS.			LAMP TRIMMERS.		
	Number.	Per cent.		Number.	Per cent.		Number.	Per cent.		Number.	Per cent.		Number.	Per cent.	
		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.
Total	2,854	100.0	.....	1,787	100.0	.....	3,760	100.0	.....	993	100.0	.....	2,282	100.0	.....
Less than 1.00	99	3.5	100.0	19	1.1	100.0	40	1.1	100.0	8	0.8	100.0	41	1.8	100.0
1.00 to 1.24	261	9.1	96.5	96	5.4	98.9	146	3.9	98.9	5	0.5	99.2	110	4.8	98.2
1.25 to 1.49	364	12.8	87.4	126	7.1	93.5	228	6.1	95.0	15	1.5	98.7	177	7.7	93.4
1.50 to 1.74	623	21.8	74.6	328	18.4	86.4	620	16.5	88.9	104	10.5	97.2	506	22.2	85.7
1.75 to 1.99	418	14.6	52.8	245	13.7	68.0	480	12.8	72.4	161	16.2	86.7	324	14.2	63.5
2.00 to 2.24	513	18.0	38.2	407	22.8	54.3	772	20.5	59.6	268	27.0	70.5	764	33.5	49.3
2.25 to 2.49	287	10.0	20.2	251	14.0	31.5	303	8.0	39.1	87	8.8	43.5	253	11.1	15.8
2.50 to 2.74	128	4.5	10.2	176	9.8	17.5	621	16.5	31.1	156	15.7	34.7	68	3.0	4.7
2.75 to 2.99	122	4.3	5.7	54	3.0	7.7	275	7.3	14.6	67	6.7	19.0	17	0.7	1.7
3.00 to 3.24	32	1.1	1.4	52	2.9	4.7	225	6.0	7.3	85	8.6	12.3	10	0.4	1.0
3.25 to 3.49	3	0.1	0.3	20	1.1	1.8	23	0.6	1.3	12	1.2	3.7	6	0.3	0.6
3.50 to 3.74	2	0.1	0.2	4	0.2	0.7	21	0.5	0.7	13	1.3	2.5	6	0.3	0.3
3.75 and over	2	0.1	0.1	9	0.5	0.5	6	0.2	0.2	12	1.2	1.2	.....	.....	.....

TABLE 52.—NUMBER OF WAGE-EARNERS AT SPECIFIED DAILY RATES OF PAY, WITH PERCENTAGES OF TOTAL AND CUMULATIVE PERCENTAGES—MUNICIPAL STATIONS: 1902.

[Each cumulative percentage shows the proportion of total number of persons in the given class receiving a wage as great as, or greater than, the lowest wage of the given wage group.]

RATE PER DAY (DOLLARS).	ALL CLASSES.			FOREMEN.			INSPECTORS.			ENGINEERS.		
	Number.	Per cent.		Number.	Per cent.		Number.	Per cent.		Number.	Per cent.	
		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.
Total	2,157	100.0	.....	50	100.0	.....	24	100.0	.....	805	100.0	.....
Less than 1.00	105	4.9	100.0	.....	.....	.....	1	4.2	100.0	8	1.0	100.0
1.00 to 1.24	201	9.3	95.1	1	2.0	100.0	.....	.....	95.8	59	7.3	99.0
1.25 to 1.49	294	13.6	85.8	4	8.0	98.0	.....	.....	95.8	104	12.9	91.7
1.50 to 1.74	440	20.4	72.2	7	14.0	90.0	.....	.....	95.8	168	20.9	78.8
1.75 to 1.99	233	10.8	51.8	1	2.0	76.0	4	16.7	95.8	84	10.4	57.9
2.00 to 2.24	418	19.4	41.0	5	10.0	74.0	7	29.1	79.1	168	20.9	47.5
2.25 to 2.49	203	9.4	21.6	7	14.0	64.0	5	20.8	50.0	65	8.1	26.6
2.50 to 2.74	166	7.7	12.2	12	24.0	50.0	5	20.8	29.2	90	11.2	18.5
2.75 to 2.99	29	1.3	4.5	3	6.0	26.0	.....	.....	8.4	15	1.9	7.3
3.00 to 3.24	34	1.6	3.2	5	10.0	20.0	1	4.2	8.4	23	2.8	5.4
3.25 to 3.49	25	1.2	1.6	3	6.0	10.0	.....	.....	4.2	18	2.2	2.6
3.50 to 3.74	2	0.1	0.4	.....	.....	4.0	.....	.....	4.2	.....	.....	0.4
3.75 and over	7	0.3	0.3	2	4.0	4.0	1	4.2	4.2	3	0.4	0.4

TABLE 52.—NUMBER OF WAGE-EARNERS AT SPECIFIED DAILY RATES OF PAY, WITH PERCENTAGES OF TOTAL AND CUMULATIVE PERCENTAGES—MUNICIPAL STATIONS: 1902—Continued.

[Each cumulative percentage shows the proportion of total number of persons in the given class receiving a wage as great as, or greater than, the lowest wage of the given wage group.]

RATE PER DAY (DOLLARS).	FIREMEN.			DYNAMO AND SWITCHBOARD MEN.			LINEMEN.			MECHANICS.			LAMP TRIMMERS.		
	Number.	Per cent.		Number.	Per cent.		Number.	Per cent.		Number.	Per cent.		Number.	Per cent.	
		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.		Of total.	Cumulative.
Total	486	100.0	.....	101	100.0	.....	339	100.0	.....	46	100.0	.....	306	100.0	.....
Less than 1.00	51	10.5	100.0	3	3.0	100.0	17	5.0	100.0	1	2.1	100.0	24	7.8	100.0
1.00 to 1.24	73	15.0	89.5	9	8.9	97.0	33	9.7	95.0	2	4.4	97.9	24	7.8	92.2
1.25 to 1.49	108	22.2	74.5	12	11.9	88.1	37	10.9	85.3	4	8.7	93.5	25	8.2	84.4
1.50 to 1.74	117	24.1	52.3	20	19.8	76.2	66	19.5	74.4	3	6.5	84.8	59	19.3	76.2
1.75 to 1.99	54	11.1	28.2	18	17.8	56.4	40	11.8	54.9	3	6.5	78.3	29	9.5	56.9
2.00 to 2.24	74	15.2	17.1	16	15.8	38.6	63	18.6	43.1	8	17.4	71.8	77	25.2	47.4
2.25 to 2.49	8	1.7	1.9	13	12.8	22.8	28	8.3	24.5	14	30.4	54.4	63	20.6	22.2
2.50 to 2.74	.....	.....	0.2	4	4.0	10.0	47	13.8	16.2	5	10.9	24.0	3	1.0	1.6
2.75 to 2.99	.....	.....	0.2	2	2.0	6.0	3	0.9	2.4	4	8.7	13.1	2	0.6	0.6
3.00 to 3.24	1	0.2	0.2	4	4.0	4.0	.....	.....	1.5	.....	.....	4.4	.....	.....	.....
3.25 to 3.49	.....	.....	.....	.....	.....	.....	2	0.6	1.5	2	4.4	4.4	.....	.....	.....
3.50 to 3.74	.....	.....	.....	.....	.....	.....	2	0.6	0.9	.....	.....	.....	.....	.....	.....
3.75 and over	.....	.....	.....	.....	.....	.....	1	0.3	0.3	.....	.....	.....	.....	.....	.....

The equipment of a station, its size, and the character of its service necessarily govern the proportion of the different classes of wage-earners to the total. This feature has already been discussed, but it may be again pointed out that small stations do not necessarily require inspectors or foremen, and that the linework might be done by lamp trimmers or mechanics, while an engineer might act as foreman, and a dynamo tender, besides watching the switchboard, could fire the boiler and oil the engine. This merging of work is, in fact, so common as to render it difficult to make any closely accurate segregation of employees according to specified occupations. The rate of pay, however, in each of these cases, while subject to varying skilled labor conditions in the vicinity, is likely to be that of the higher class, in order to compensate properly for the variety of skill required and for the large amount of responsibility assumed. It stands to reason that a fireman performing the work of an engineer would be much more likely to consider and rate himself in the higher class than in the lower, even though his wages were not commensurate with the more exacting position.

Median rates of pay.—By a median rate of wages is meant the rate of the employee who stands halfway between the lowest paid and the highest paid employee in the class under consideration; in other words, an absolutely precise median would be a rate such that the number of employees receiving wages higher than the rate named is equal to the number receiving lower wages. For the purpose of permitting the medians to be calculated closely, the schedule called for a classification of wage-earners by their precise daily rates of pay. In tabulation, however, the employees have necessarily been grouped according to certain limits, and the median in each case accordingly appears not as a single rate but as a group, with upper and lower limits 5 cents apart. It follows that the median group itself covers a considerable number of employees and that the numbers above and below the median group are not, as a rule, exactly equal.

Tables 53 and 54 show, for the same wage-earners who are covered by Tables 51 and 52, the median groups of wages for different occupations, the percentage of the total number within each occupation who received wage rates falling within the median group, and the percentages of those above and of those below the median rates.

TABLE 53.—*Median rate of wages and percentage of classified wage-earners receiving above, below, and median rate—private stations: 1902.*

CLASS OF OCCUPATION.	Median rate (dollars).	PER CENT OF WAGE-EARNERS RECEIVING—		
		Median rate.	Above median rate.	Below median rate.
All classes	2.00 to 2.04	18.9	36.9	44.2
Foremen	2.85 to 2.89	1.4	49.8	48.8
Inspectors	2.00 to 2.04	23.1	44.3	32.6
Engineers	2.00 to 2.04	15.0	41.6	43.4
Firemen	1.75 to 1.79	9.8	43.0	47.2
Dynamo and switchboard men	2.00 to 2.04	19.0	35.5	45.5
Linemen	2.00 to 2.04	17.4	42.3	40.3
Mechanics	2.00 to 2.04	25.6	44.9	29.5
Lamp trimmers	1.90 to 1.94	1.1	49.7	49.2

TABLE 54.—*Median rate of wages and percentage of classified wage-earners receiving above, below, and median rate—municipal stations: 1902.*

CLASS OF OCCUPATION.	Median rate (dollars).	PER CENT OF WAGE-EARNERS RECEIVING—		
		Median rate.	Above median rate.	Below median rate.
All classes	1.75 to 1.79	4.6	47.2	48.2
Foremen	2.45 to 2.49	4.0	50.0	46.0
Inspectors	2.25 to 2.29	20.8	29.2	50.0
Engineers	1.95 to 1.99	3.2	47.5	49.3
Firemen	1.50 to 1.54	12.8	39.5	47.7
Dynamo and switchboard men	1.75 to 1.79	7.9	48.5	43.6
Linemen	1.75 to 1.79	6.5	43.7	49.8
Mechanics	2.25 to 2.29	17.4	37.0	45.6
Lamp trimmers	1.80 to 1.84	4.9	49.0	46.1

Table 53 shows that the median rate of wages in private stations was $2 to $2.04 for all classes and for inspectors, engineers, dynamo and switchboard men, linemen, and mechanics, 18.9 per cent of all wage-earners included in Table 51 receiving this rate. The median rate for foremen was $2.85 to $2.89; 1.4 per cent receiving this rate.

As shown in Table 54, 4.6 per cent of the wage-earners in municipal stations received the median rate for all classes, $1.75 to $1.79. The median rate for engineers was $1.95 to $1.99; 3.2 per cent received that rate and only 49.3 per cent received less. The median rate for firemen was only $1.50 to $1.54, and 47.7 per cent received a lower rate.

When it is considered that the vast majority of municipal stations are in very small communities, it is not surprising that the private stations situated in communities where the higher cost of living must necessarily govern conditions, should pay a larger proportion of the higher wages. There is no superficial reason why an artisan should work for a municipal station at a lower rate than he would for a private station, even if it be conceded that the employment of wage-earners in municipal stations might be governed by political considerations. This apparent difference might possibly disappear to some extent if the number of hours constituting the day's work were taken into consideration. It is a well-known fact that the eight hour day is a legal requirement for municipal work in some states, and would therefore apply in small as well as in large communities. Another fact that has bearing upon the conditions is that many of the municipal stations are operated chiefly or solely to supply a small number of lamps for street lighting during a restricted number of hours of darkness, and hence in such stations the nominal working day would involve fewer hours of occupation than it would in private stations or in other stations doing all kinds of electric work all day long; consequently the rate of pay would be lower in the municipal stations.

Daily wages and median rates, by states.—In Tables 95 and 96 the statistics of the wage-earners shown in Table 50 are presented, by states and territories, for private and municipal stations, respectively, the number of wage-earners being given for all occupations; and also for the more important occupations separately, according to daily wages within stated 25-cent limits; the 5-cent group, within which the median wage falls, is also given in each case.

The highest wages in private stations were paid in Montana, where the median for all classes of wage-earners was $3 to $3.04. Other states approaching this high average are found in the Western group. Important states that had a median of $2 to $2.04 were New York, New Jersey, Missouri, Minnesota, and Connecticut. In the Southern states the median rate was very low, it being $1.50 or less in a number of states. In Montana the median rate for engineers was $4 to $4.04. In no other state was this high rate approached, but in a number of important states daily wages of from $2 to $2.50 were paid.

For municipal stations few states reported a median rate of more than $2.04 for all classes of wage-earners. In fact none of the larger states except California, Illinois, and Massachusetts did so.

The other data in these tables do not call for comment, but will be of interest to the student of sociology.

CHAPTER V.

PHYSICAL EQUIPMENT.

General divisions.—The physical equipment of central stations by means of which service is rendered to the community embraces three important subdivisions.

The first of these comprises the power and generating station equipment, with which is included that of substations. The second includes all items relating to the line construction, extending from the power stations and substations in the shape of mains, feeders, and subsidiary circuits to the street circuits or to the premises of consumers. With this should, in all propriety, be grouped apparatus such as transformers, which are very often placed on the line itself, although they are frequently to be found on consumers' premises. The third group of physical equipment includes the meters, the arc and incandescent lamps, the stationary motors, and some other apparatus, although it is often difficult to distinguish the apparatus belonging to the stations from that belonging to the consumer.

In preceding tables gross figures have been presented for some of the items of the physical equipment. Tables 73 to 76 and 83 to 86 give for private and municipal stations, respectively, detailed statistics, by states, concerning the electric line construction, the power and generating apparatus within the station, the transmitting equipment in the substations, the transformers, the meters, the output of current, the number and varieties of arc and incandescent lamps, and the number of stationary and railway car motors.

Ownership of equipment.—It is to a large extent the present practice for the customers employing motors driven by electric current from central stations to own the motors outright. In a great many instances the incandescent lamps connected to the central station circuits are installed on circuits within buildings, in such a manner that neither circuits nor sockets constitute part of the physical equipment of the company supplying the current to the building, although some companies make a free service of renewal lamps to them. Arc lamps, where used for street lighting, have remained, with few exceptions, wholly the property of the stations operating them under contract with the city or the municipality itself; and this is equally true of all arc lamps supplied to the commercial customers, whether by private stations or by municipal plants. It is an unusual thing for the proprietor of a store or building to own the arc lamps operated on his premises if such lamps happen to be energized with central station current, although where the plants are of the description known as "isolated," such lamps, as well as all other apparatus, are owned by the owner of the building or by the tenant. Transformers have likewise remained, as a general thing, the property of the stations operating them, being, in fact, moved from place to place according to the local requirements of the system. Meters on central station circuits are, it is safe to say, invariably the property of the stations, and are taken out in case the service is discontinued. The apparatus under consideration is, therefore, that which is the property of the central station strictly, subject to the limitations that have been pointed out with regard to one or two classes of consumption appliances.

I.

EQUIPMENT OF POWER AND GENERATING PLANTS.

General statistics of power plants.—As already shown in Table 1 the total horsepower capacity of steam engines and water wheels of central electric stations was 1,818,413 horsepower. Of this amount 1,379,941 horsepower, or 75.9 per cent, was the indicated capacity of the steam engines, and 438,472 horsepower, or 24.1 per cent, the stated capacity of the water wheels. The indicated capacity of steam engines and water wheels in the stations operated under private ownership was 1,660,177 horsepower, or 91.3 per cent of the total, while the capacity of those in stations operated under municipal control was 158,236 horsepower, or 8.7 per cent.

In addition to the power shown in Table 1 there were reported 165 gas engines, having a capacity of 12,181 horsepower, and 365 auxiliary steam engines, having a capacity of 14,454 horsepower. As a matter of fact, the gas engines should be regarded as part of the prime moving power plant, it being probable that practically all such engines reported were attached to dynamos. It is also probable that some of the auxiliary steam engines were in the nature of a reserve as well as for use in operating subsidiary apparatus in connection with the plant. Tables 74 and 84 present, for the United States and for each of the states and territories, detailed statistics of these engines and water wheels, classified according to size, as well as details concerning the dynamos and other apparatus in the private and municipal stations, respectively.

General statistics of steam engines.—Table 55 shows the number and horsepower of the steam engines in both private and municipal stations, also the proportion that the equipment of each class of stations is of the total.

TABLE 55.—*Steam engines—private and municipal stations, and percentage each class is of total: 1902.*

CLASS OF ENGINE.	Total.	Private stations.	Municipal stations.	PER CENT— In private stations.	PER CENT— In municipal stations.
Total:					
Number	5,930	4,870	1,060	82.1	17.9
Horsepower	1,379,941	1,232,923	147,018	89.3	10.7
500 horsepower and under—					
Number	5,451	4,407	1,044	80.8	19.2
Horsepower	849,336	715,418	133,918	84.2	15.8
Over 500 and under 1,000 horsepower—					
Number	278	266	12	95.7	4.3
Horsepower	193,570	184,670	8,900	95.4	4.6
1,000 horsepower and over—					
Number	201	197	4	98.0	2.0
Horsepower	337,035	332,835	4,200	98.8	1.2

Of the total horsepower of the steam engines in use in central electric stations 89.3 per cent represents engines in private stations and 10.7 per cent those in the municipal stations. Not only does the horsepower of the engines in the municipal stations form a small proportion of the total, but the engines are, as a rule, smaller than the engines in stations operated under private ownership. This is shown in the arrangement of the engines into three groups according to their horsepower. The vast majority of the engines in the municipal plants are in the group of the smallest capacity, while those of a larger capacity are almost all in private stations. The greatest disparity between the two groups of stations is in the group having engines with a capacity of 1,000 horsepower and over. This included 201 engines with a total capacity of 337,035 horsepower. Of these only 4, with a capacity of 4,200 horsepower, were reported by municipal stations. It will be noted that even these 4 came barely within the classification, while the 197 in the private stations rose to an average of very nearly 1,700 horsepower each. These facts should not be overlooked in a consideration of the various costs and economies affecting the production and sale of current, or the rates at which service can be supplied, it being a truism that power production on a large scale is cheaper than power production on a small scale. Table 56 brings out these facts more clearly by showing the percentages that the number and horsepower of engines in the different groups were of the total number and horsepower of the engines in all stations, and in private and municipal stations, respectively.

TABLE 56.—*Percentages that the number and horsepower of the different classes of steam engines are of total—private and municipal stations: 1902.*

CLASS OF ENGINE.	Total.	Private stations.	Municipal stations.
Total:			
Number	100.0	100.0	100.0
Horsepower	100.0	100.0	100.0
500 horsepower and under—			
Number	91.9	90.5	98.5
Horsepower	61.6	58.0	91.1
Over 500 and under 1,000 horsepower—			
Number	4.7	5.5	1.1
Horsepower	14.0	15.0	6.0
1,000 horsepower and over—			
Number	3.4	4.0	0.4
Horsepower	24.4	27.0	2.9

The engines having 500 horsepower and under formed 91.9 per cent of all engines, their capacity being 61.6 per cent of the total capacity. The smaller engines and their total horsepower form a considerably larger proportion of the total for the municipal stations than they do of the total for the private stations, while the larger engines, those having over 500 horsepower, form a larger proportion of the total in the private than in the municipal stations. In private stations the engines of 1,000 horsepower and upward were 3.4 per cent of the number and 24.4 per cent of the horsepower, but in the municipal stations they were only four-tenths of 1 per cent of the number and 2.9 per cent of the horsepower. While it is evident that the smaller type of engines largely predominates in all the stations taken collectively, the proportion of them in the municipal stations is overwhelming. Such figures are a strong indication of the facts already emphasized in other ways, that, taking the country as a whole, outside of the large cities the electric light and power industry is still based on what has to be considered as a quite small and relatively expensive unit of motive power.

The number of engines per municipal station is not much above one and even in the private stations the average does not rise to two, this fact showing how very general the dependence is upon one engine, even a reserve for accidents and emergencies being lacking. The average capacity per plant for the municipal stations was about 180 horsepower and in the private stations almost 440 horsepower. It will be remembered, however, that if the stations using waterpower exclusively be deducted from the totals these averages will be raised somewhat.

Auxiliary steam engines.—It is possible that in some of the stations the auxiliary steam engines would come to the relief of the main plants in moments of distress. In private stations there were 329 such engines, with 13,619 horsepower capacity. In the municipal stations there were few auxiliary engines, the number being but 36, with 835 horsepower; evidently they were in reality merely auxiliaries in most cases, for although one is reported of 200 horsepower and one of 100 horsepower,

the average capacity for the remainder was not quite 16 horsepower. In the private stations the auxiliary steam engines had an average capacity of 41 horsepower, and while many of the smaller ones were used for pumping, a number were of sufficient size to take care of a good sized arc lighting machine, to carry a moderate day load, or to charge storage batteries.

Steam engines in stations, classified according to population of places in which located and dynamo capacity.—Tables 87 to 90 show the equipment of central electric stations, classified according to the population of the places in which they were located. These tables show very strikingly the use of the larger steam engines in the larger cities, the number of large engines rising rapidly as the population increases. Thus, as shown in Table 87, for the purely electric private stations, of the steam engines of 500 horsepower and under, 1,593 were in places with less than 5,000 inhabitants and only 119 in places of a population of more than 500,000, while of the engines of 500 horsepower and over there were only 2 in places with less than 5,000 inhabitants, 9 in places with from 5,000 to 25,000, 67 in places with from 25,000 to 100,000, 104 in places with from 100,000 to 500,000, and 120 in places with more than 500,000.

In Table 88, for private stations operated in connection with other business, the results are similar to those shown in the preceding table, although the variations are less marked, which is but natural since many of these stations are operated merely as accessories to some other business.

Municipal stations, for which the statistics are shown in Tables 89 and 90, have, as a rule, very small plants, and consequently nearly all of their steam engines are of the smaller sizes. The few engines of the larger sizes are found only in the large cities.

Tables 91 to 94 show statistics of stations, classified according to the horsepower capacity of dynamos. There are very few stations having a large dynamo capacity that do not have some of the smaller sized engines in connection with their larger ones. Thus, in the purely electric private stations having a dynamo capacity of 5,000 horsepower and over, there were 162 steam engines of 500 horsepower and under, 82 of over 500 but under 1,000 horsepower, and 121 of 1,000 horsepower and over. These figures appear to indicate that the smaller engines are used during certain parts of the day when there is comparatively little call for current, and as a reserve in case of accident to the larger engines.

Table 92 follows the same general line as Table 91. Tables 93 and 94, for municipal stations, have so few steam engines of the larger sizes that they do not call for comment.

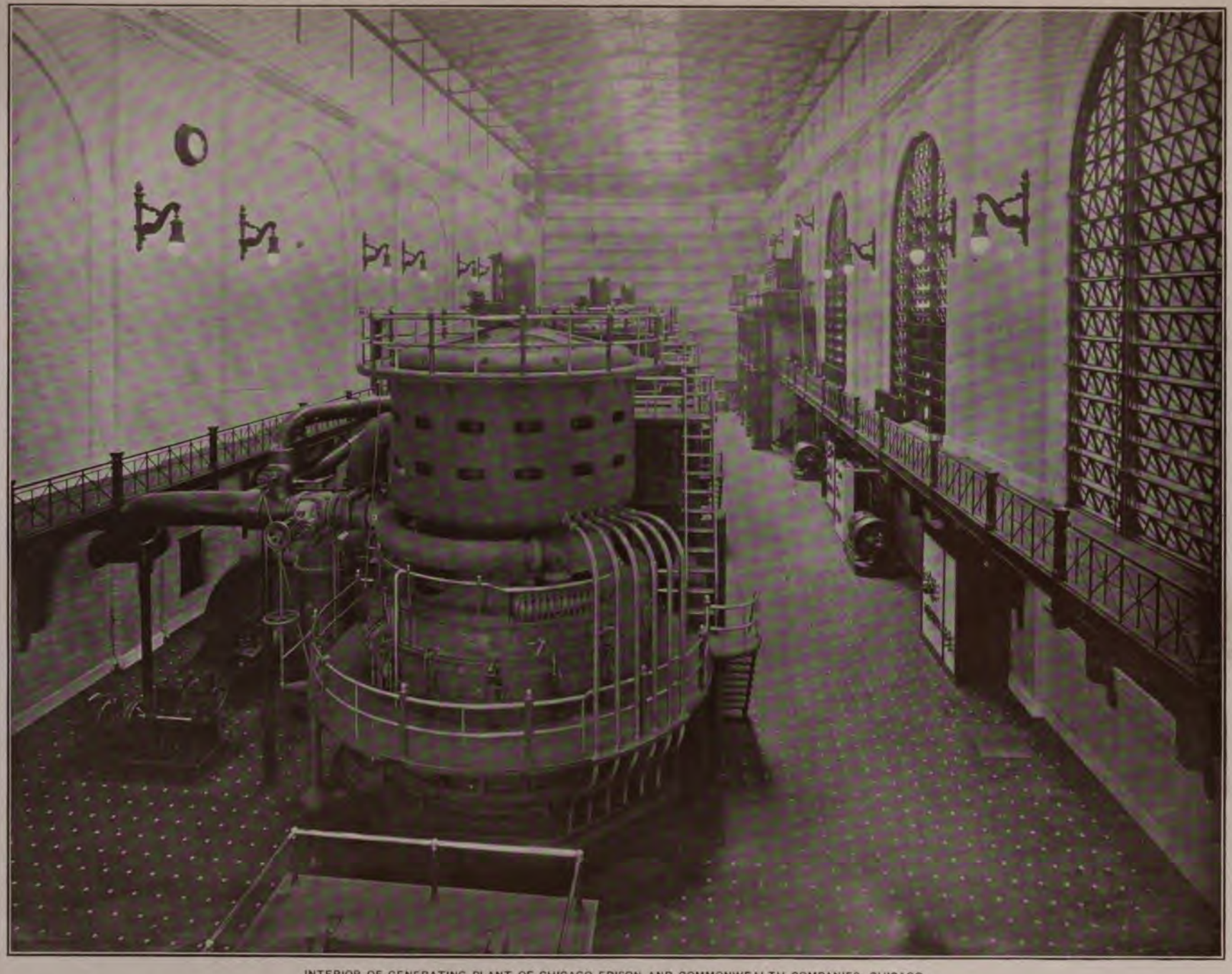
General statistics of water wheels.—Of the primary motive power plants in use in central stations the considerable proportion represented by hydraulic development is enumerated and broadly analyzed in Table 57. This table shows the number and horsepower capacity of water wheels divided into three groups as to size, in all, in the private, and in the municipal stations, respectively, and the proportion which those in each class of stations are of the total.

TABLE 57.—*Water wheels—private and municipal stations, and percentage each class is of total: 1902.*

CLASS OF WATER WHEEL.	Total.	Private stations.	Municipal stations.	PER CENT— In private stations.	PER CENT— In municipal stations.
Total:					
Number	1,390	1,308	82	94.1	5.9
Horsepower	438,472	427,254	11,218	97.4	2.6
500 horsepower and under—					
Number	1,192	1,112	80	93.3	6.7
Horsepower	174,559	164,981	9,578	94.5	5.5
Over 500 and under 1,000 horsepower—					
Number	85	84	1	98.8	1.2
Horsepower	57,160	56,520	640	98.9	1.1
1,000 horsepower and over—					
Number	113	112	1	99.1	0.9
Horsepower	206,753	205,753	1,000	99.5	0.5

For all stations, 1,390 water wheels were reported, and they had a stated capacity of 438,472 horsepower. Of these 1,308, with a capacity of 427,254 horsepower, were in private stations and 82, with a capacity of 11,218 horsepower, in municipal stations, this latter class of stations having 5.9 per cent of the number and 2.6 per cent of the horsepower. As with the steam engines so with the water wheels; by far the largest number were in the group of 500 horsepower and under, the municipal stations having only 2 of a greater capacity. No fewer than 1,192 wheels, with a total of 174,559 horsepower, were in this group; of these all but 80, with 9,578 horsepower, were in private stations. There were 85 wheels, with a total of 57,160 horsepower, in the group with a capacity of between 500 and 1,000 horsepower, and 113, with a total of 206,753 horsepower, in the group with a capacity of 1,000 horsepower and over. In the private stations the average for all the wheels in the second group was slightly over 672 horsepower, and for those in the largest group the average was 1,837 horsepower. It will be interesting to note that the group of the small water wheels comprised 39.8 per cent of the total horsepower, while the horsepower of the wheels in the group of 1,000 horsepower and over was 47.2 per cent.

Water wheels in private stations.—According to Table 74 the water wheel power plant equipment of private stations showed a remarkably wide distribution throughout the country, waterpower being used in all but a few of the smaller and less important states and territories. But while the smaller steam engines represented more than half of the total capacity of steam engines, the opposite is true as regards water wheels. The 196 water wheels of over 500 horsepower aggregated 262,273 horsepower, or nearly two-thirds of the total, while the



INTERIOR OF GENERATING PLANT OF CHICAGO EDISON AND COMMONWEALTH COMPANIES, CHICAGO.

This plant is a striking exemplification of the latest modern practice in employing dynamos driven by steam turbines. The dynamo and turbine together constitute a complete turbo-generator unit.

112 wheels of 1,000 horsepower and over, included in the 196 wheels, were of 205,753 horsepower, or very nearly one-half of the total. The average size of all the wheels was 326 horsepower, while the 1,112 constituting the most numerous group averaged only 148 horsepower each.

New York occupies a conspicuous place at the head of the list, with 236 wheels and a total of 128,271 horsepower. Although the development of Niagara Falls power figures very materially in the high standing of New York for hydraulic development, the distribution of waterpower throughout the state is very general. Only 47 of the wheels were over 500 horsepower, while the average of wheels having less than 500 horsepower was only 157 horsepower each. The influence of the Niagara Falls development is most clearly shown in the group of large wheels, there being in this group 35 wheels of a total of 91,600 horsepower, an average of 2,617 horsepower per wheel. California, with a total of 130 wheels and 78,483 horsepower, was the second state in the use of waterpower for the generation of electric current. Here again the distribution was general, the wheels varying greatly in size, there being by groups 79 with 12,771 horsepower, 23 with 15,574 horsepower, and 28 with 50,138 horsepower. This last group comprised almost two-thirds of the total stated capacity. The average capacity of wheels in the first group was 161 horsepower, while the average of those in the last group was 1,790 horsepower. Considerable utilization of waterpower is shown in the New England states, Vermont leading with 64 water wheels of 13,075 horsepower. The hydraulic utilization was also noteworthy in several of the Central and Western states, namely, California with 130 wheels and 78,483 horsepower, Colorado with 42 wheels and 12,750 horsepower, Illinois with 52 wheels and 9,505 horsepower, Michigan with 95 wheels and 12,915 horsepower, Montana with 44 wheels and 24,000 horsepower, Oregon with 44 wheels and 11,118 horsepower, Utah with 25 wheels and 18,285 horsepower, Washington with 41 wheels and 17,238 horsepower, and Wisconsin with 74 wheels and 7,423 horsepower. The states in the Far West were more conspicuous than those of New England or the Middle West in the employment of large wheels. For example, 11 of the 25 wheels in Utah were of over 1,000 horsepower each, while of the 42 in Colorado 2 were of over 1,000 horsepower and 6 were of between 500 and 1,000 horsepower and averaged more than 700 horsepower each. Georgia, with 10 wheels of 5,989 horsepower, of which 4 were of 5,150 horsepower, is one of the Southern states giving attention to waterpower or its better availability. South Carolina was also notable for its utilization of waterpower. It had 9 wheels of 10,415 horsepower, 8 of which were of 10,165 horsepower or an average of 1,270 horsepower each. In Pennsylvania, in spite of the nearness of the central stations to the coal measures, waterpower was utilized quite freely although in small units, there being 48 wheels with a total of 6,703 horsepower; 46 of these were of less than 500 horsepower each and in fact did not average much over 100 horsepower each.

Water wheels in municipal stations.—The use of waterpower by the municipal stations was, as already noted, not very extensive, there being only 82 wheels with a total of 11,218 horsepower, an average of 136 horsepower per wheel. There were only 2 wheels of the larger sizes—one of 640 horsepower at Lyndonville, Vt., and one of 1,000 horsepower at Marquette, Mich. Only 18 of the states and territories reported the use of hydraulic power for municipal station purposes. The state with the largest resources of this kind was Michigan, with 19 wheels of 3,170 horsepower capacity. Next came Vermont, with 16 wheels of 3,221 horsepower. The figures for the other states do not call for comment.

Water wheels in stations, classified according to population of places in which located and dynamo capacity.—Tables 87 to 90 show the water wheels of stations, classified according to the population of the places in which located, while Tables 91 to 94 show the water wheels of stations, classified according to horsepower capacity of dynamos.

From Table 87 it will be seen that 499, or more than half of the water wheels in purely electric private stations, were found in places with a population of less than 5,000; 220, in places of 5,000 to 25,000; 126, in places of 25,000 to 100,000; and 51, in places of 100,000 to 500,000. It will be noticed that the capacity of the wheels in places of 5,000 to 25,000 was 139,025 horsepower, much more than in any other group. This is accounted for by the fact that a number of large waterpower plants are located in these small places, even though part of the current generated there is transmitted to the larger cities. Comparatively few of the larger cities employed waterpower for generating current, the 51 wheels reported in places of 100,000 to 500,000 inhabitants being limited to a very few cities.

In the private stations operated in connection with other business, the same general proportions and conditions are found, while in the municipal stations the number of the larger wheels is so few as not to call for comment.

Equipment of stations, classified according to the kind of power used.—Tables 40 and 41 show the statistics of equipment and output of current for stations classified according to the kind of power used. The figures for the last class shown in the tables are greatly influenced by the large plants at Niagara, and were it not for these plants the averages would be quite small.

As shown by Table 42, in the plants operated exclusively by waterpower there were 612 water wheels with a capacity of 217,261 horsepower and 750 dynamos with a capacity of 171,988 horsepower. According

to Table 1, the total number of water wheels in private and municipal stations was 1,390 and their capacity was 438,472 horsepower. The two tables indicate, therefore, that 44 per cent of the wheels and 49.5 per cent of their capacity were in stations operated exclusively by waterpower. The output of these 312 plants was 258,698,131 kilowatt hours for the year, this current being consumed in part by 9,060 arc lamps and 599,938 incandescent lamps.

Generating equipment.—Equal in importance with the power plant equipment in central stations, and necessarily so closely associated with it that the two form one element for consideration, is the generating plant equipment; that is, the dynamos which furnish current to the consumption circuits. The boilers, engines, and water wheels employed for prime motive power in this work are of well-nigh every variety, while the dynamos themselves comprise a bewildering assortment of shapes and sizes and are based upon varying theories of construction and design. The whole object, however, of the power and generating plant equipment is to secure the revolution of electro-magnets or coils of wire in the close vicinity to and in the "field of force" of other electro-magnetic coils of wire, such magnets and coils constituting in their relationships a dynamo electric machine. It is a matter of indifference whether the "armature" or the "field" magnet revolves; the engine or the water wheel effects its purpose so long as it causes the coils of wire to which its shaft is attached to change their positions frequently in the unseen "field of force," thus generating current. The engines may be single or compound, horizontal or vertical, condensing or noncondensing; the water wheels may be undershot or overshot, impulse or otherwise, so long as they serve the purpose of imparting rotary motion to the dynamo or generator, which may be, as it almost invariably is in later types, directly connected to the shaft of the prime mover, or, as it was in most of the early types, intermediately connected by means of belts and countershafting. The statistics relative to the power plant equipment show the figures of engines and water wheels, without regard to the distinctions of principle in their construction. In like manner the generating plant equipment might be discussed in far greater detail were this report strictly a technical treatment of the subject, but since it deals with commercial and industrial conditions, it was deemed sufficient by the Bureau of the Census to group the dynamos into three large main classes which answer sufficiently the purpose and scope of the investigation.

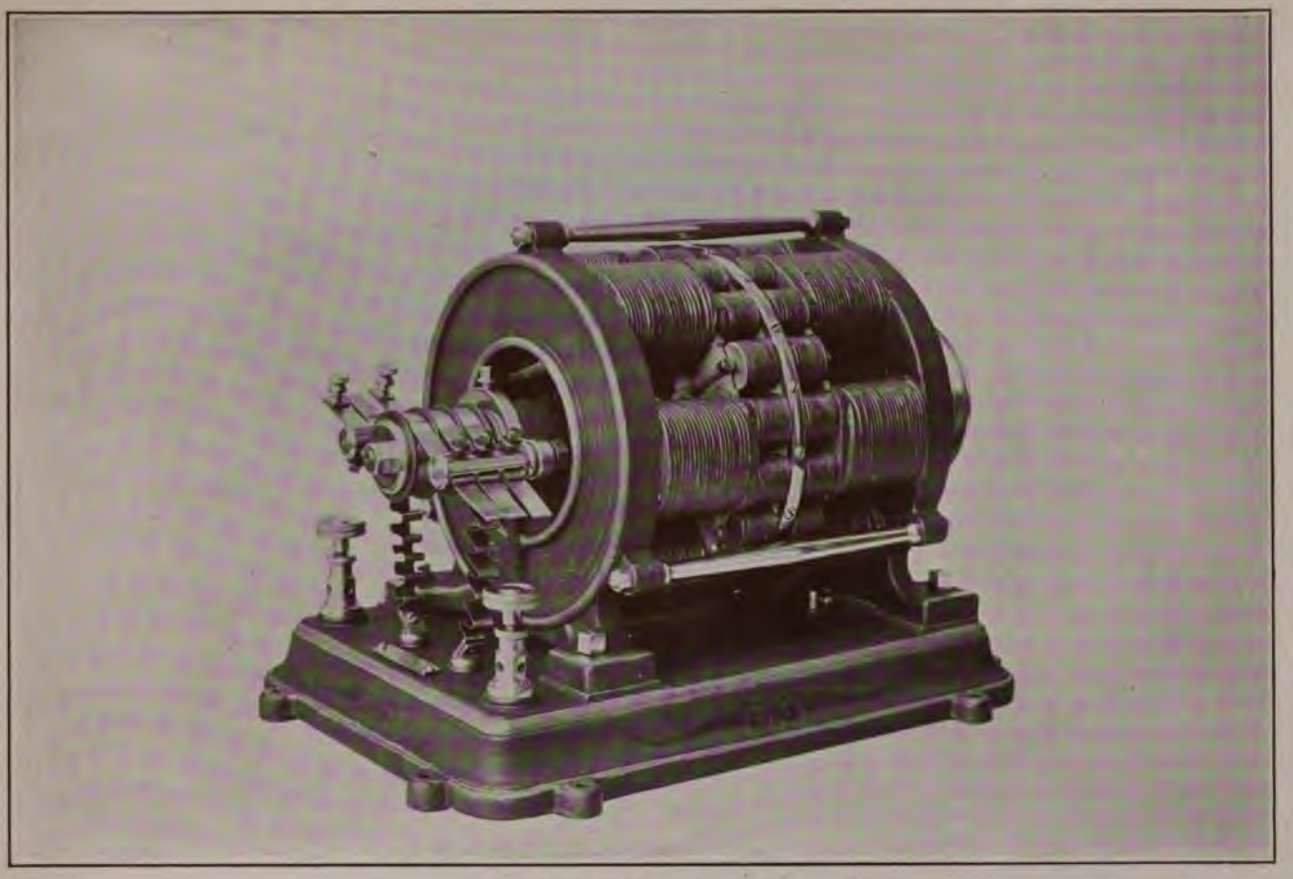
Classification of dynamos.—The generating plant equipment is divided into three groups, namely, direct current constant voltage dynamos, direct current constant amperage dynamos, and alternating and polyphase current dynamos. These three classes answer in their general range to the specific lines of work that have been developed by American central stations. The first class of direct current constant voltage machines deals with and includes essentially all those intended for supplying current to incandescent lighting and stationary motor circuits. At the outset of the industry such machines were almost without exception limited purely to incandescent lighting; but to-day, as a result of the evolution of the industry, a great many of them are furnishing current to motors and are also carrying on their circuits arc lamps, for which originally the machines in the second category, namely, those of the direct current constant amperage type, were built exclusively. A great many such constant amperage machines are still in use and are likely to be devoted solely to arc lighting in the smaller stations of the country, as will appear later from the analysis.

The third group of apparatus, alternating current dynamos, is a large and rapidly growing class which embraces in its capabilities the power of easily and readily furnishing current for all classes of lamps and for stationary motors, although between the points of generation and consumption manipulation and transformation of current may be necessary. While electric light and power in American isolated plants have been and seem likely to continue to be governed by the conditions of direct current dynamos, the central station industry is shifting rapidly to the fundamental basis of alternating current generation by means of single phase or polyphase dynamos. This broad statement is subject to qualifications which would not, however, lessen the value of the assertion.

General statistics of generating plants.—The gross figures for the three classes of dynamos give a total of 12,484 machines, with a stated capacity of 1,624,980 horsepower. Table 58 shows the distribution of these dynamos according to the character of the current and according to location in private or municipal stations, also the proportion of each variety of machines in each class of stations.

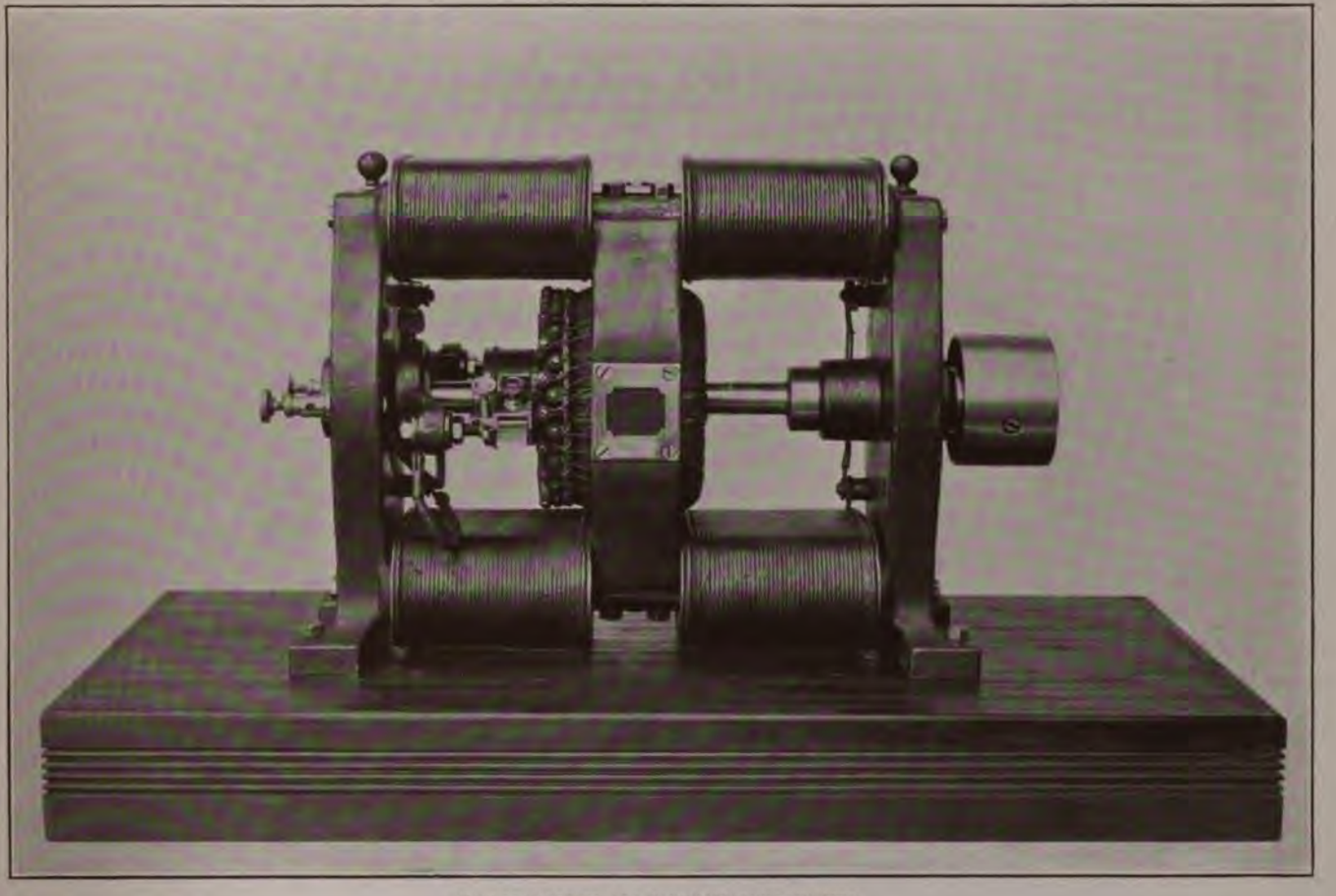
TABLE 58.—*Dynamos—private and municipal stations, and percentage each class is of total: 1902.*

VARIETY OF DYNAMO.	Total.	Private stations.	Municipal stations.	PER CENT— In private stations.	PER CENT— In municipal stations.
Total:					
Number	12,484	10,662	1,822	85.4	14.6
Horsepower	1,624,980	1,472,996	151,984	90.6	9.4
Direct current, constant voltage—					
Number	3,823	3,405	418	89.1	10.9
Horsepower	442,446	418,913	23,533	94.7	5.3
Direct current, constant amperage—					
Number	3,539	2,957	582	83.6	16.4
Horsepower	195,531	157,768	37,763	80.7	19.3
Alternating and polyphase current—					
Number	5,122	4,300	822	84.0	16.0
Horsepower	987,003	896,315	90,688	90.8	9.2



"WOOD" DYNAMO BUILT IN 1879.

This machine includes many of the features of the modern dynamo, and is the multipolar type.



"WOOD" SERIES ARC DYNAMOS BUILT IN 1880.

This series arc dynamo was the forerunner of a well-known type that has survived for twenty-five years; designed for 9.6 amperes and 50 volts, at 2,200 revolutions of the armature per minute.

In view of the fact that municipal stations are so largely devoted to street lighting, it is natural that for them the class of direct current constant amperage arc machines should be the largest. The relatively small amount of incandescent lighting done in municipal stations is also brought out by the fact that in such stations direct current constant voltage dynamos formed only 10.9 per cent of the total number and had only 5.3 per cent of the total horsepower. The machines in most general use in both classes of stations were those generating alternating current, single or polyphase. Of the total number of these machines reported, 16 per cent with 9.2 per cent of the horsepower were operated in municipal stations.

Table 59 shows the percentages that the number and horsepower of the different varieties of dynamos are of the total number and total horsepower of all dynamos in all stations and in both private and municipal stations.

TABLE 59.—*Percentages that the number and horsepower of the different varieties of dynamos are of total—private and municipal stations: 1902.*

VARIETY OF DYNAMO.	Total.	Private stations.	Municipal stations.
Total:			
Number	100.0	100.0	100.0
Horsepower	100.0	100.0	100.0
Direct current, constant voltage—			
Number	30.6	32.0	22.9
Horsepower	27.2	28.4	15.5
Direct current, constant amperage—			
Number	28.4	27.7	32.0
Horsepower	12.0	10.7	24.8
Alternating and polyphase current—			
Number	41.0	40.3	45.1
Horsepower	60.8	60.9	59.7

Alternating current apparatus, in spite of the lateness of its introduction, had at the time of the collection of these statistics become the largest class of apparatus employed in central station work, as shown by the gross figures. Not only did such machines constitute the largest proportion as to number, but their proportion of the total horsepower was also considerably in excess, indicating, as might be expected from the later developments in the industry, the employment of a much larger type of machine of this variety than is now to be found in service either for direct incandescent lighting or for direct current arc lighting.

According to Table 59, direct current constant voltage machines were 30.6 per cent of the number and had 27.2 per cent of the horsepower. Direct current constant amperage or arc machines were slightly inferior as to number, the rate being 28.4 per cent, and very much less as to horsepower, for which the rate was 12 per cent. On the other hand, the alternating class embraced 41 per cent of the number and 60.8 per cent of the horsepower. It may here be pointed out that the use of alternating and polyphase machines in municipal stations has kept pace with their use in private stations, the rates being 60.9 per cent for private stations and 59.7 per cent for municipal stations.

Dynamos in private stations.—Table 74 shows the division of dynamos, by states and territories, in private stations and includes also in the classification of dynamos apparatus 184 boosters of 17,735 horsepower, and 131 rotaries of 63,683 horsepower. Two states were very largely in the lead as to number and capacity of dynamos, namely, New York with 1,408, with a total of 245,823 horsepower, and Pennsylvania with 1,215, with a total of 155,377 horsepower.

The large states had a considerable proportion of alternating current apparatus. Of the dynamos in New York 690, with 166,427 horsepower, were of this class. In Pennsylvania there were 405, with 83,793 horsepower; in Illinois 336, with 58,099 horsepower; and in Massachusetts 233, with 59,143 horsepower. These alternating machines were frequently of considerable size, those in New York, for instance, averaging over 241 horsepower. The fact that in this state there were only 33 dynamos of 1,000 horsepower and over, the total capacity being 79,520 horsepower, would imply the presence of a large number of the smaller and older single phase alternating machines, as distinguished from the polyphase machines, now built only in the very large sizes. In fact the central station industry, as a whole, still employed a large number of these smaller dynamos which marked the introduction of that kind of current some years ago, such machines being not much if any larger than the average of 193 horsepower each. In the other states the relative size of the direct and alternating current apparatus, exclusive of that for arc lighting, followed closely the same relative magnitudes.

The arc lighting machines reported had an average capacity of a little over 53 horsepower. In New York the average was less than 50 horsepower, the probability being that in that state the industry had already reached the stage where a great many of the arc lamps were carried on the incandescent lighting circuits, instead of on circuits and machines of the earlier series arc type, such as would still prevail in smaller communities. It will be noted that in several of the states for which the reports showed a small number of arc lighting machines, the average was considerably above the average for the country as a whole. Thus in Indian Territory the single machine reported was of 60 horsepower. In New Mexico the 3 with 183 horsepower, averaged 61 horsepower. In Utah the 10 with 800 horsepower, averaged 80 horsepower. Toward the close of what was a definite period of series arc lighting with machines of this type, the tendency was to increase the capacity of dynamos very materially, so that a single machine would energize a circuit with as many as 150 series arc lamps, and thus enable the business to be done more economically and at the same time over a larger area. Moreover, in order to drive the current through this long circuit of wire and lamps, the pressure or voltage had to be increased pro-

portionately, and while better precautions were taken as to insulation, it was universally felt that such circuits were far too dangerous to life and property to be permitted a very general adoption, even if the wires reached the poles by underground conduits. These statistics as to arc lighting dynamos give a very fair indication of the continued existence and use of many of the larger arc machines, although they were built and installed prior to the time when the alternating current made its appearance and by its different method of current distribution obviated the necessity of their employment.

Dynamos in municipal stations.—Table 84 presents the statistics, by states and territories, for dynamos in the municipal stations of the country, there being, as already noted, 1,822 dynamos with a total of 151,984 horsepower, of which exactly 1,000 with 61,296 horsepower were of the direct current type, leaving for the class of alternating and polyphase current 822 with 90,688 horsepower.

An inspection of the table shows that a great many of the machines were very small. The direct current machines considered as one group averaged 61 horsepower and the alternating current machines averaged 110 horsepower. In Colorado the 1 direct current incandescent lighting machine was of only 30 horsepower; in Connecticut the 4 incandescent lighting machines had a total capacity of only 80 horsepower and the 2 arc machines had a total of only 40 horsepower, the average for both kinds of machines being but 20 horsepower. The single direct current incandescent lighting machine in Massachusetts was of 80 horsepower, while in Oregon the 3 of the same type had a total of only 39 horsepower, and in South Carolina there were 2 with a total of only 35 horsepower. In Vermont there were 3 with a reported total of 8 horsepower. It is difficult to conceive what useful or economical part machinery of such trivial capacity could play in any enterprise, whether private or municipal. For Vermont the reports showed also 3 direct current arc machines with a total of 70 horsepower, while 4 of the arc machines in Virginia had a total of but 75 horsepower. In West Virginia, however, the arc machines ran to the other extreme, 9 being reported with a total of 700 horsepower.

All the small machines, including the group of alternating current apparatus, were without question of the early single phase type. This dynamo electric apparatus for generating purposes was supplemented by a very small number of boosters and rotaries, there being 9 boosters with 176 horsepower and 1 rotary with 134 horsepower.

Dynamos in stations, classified according to population of places in which located and dynamo capacity.—Tables 87 to 90 show the statistics of dynamos for stations, classified according to the population of the places in which located, and Tables 91 to 94 show similar statistics for the stations classified according to horsepower capacity of generating equipment.

According to Table 87, in purely electric private stations, the places with a population of less than 5,000 had the largest number of dynamos, as well as the largest horsepower capacity. In a general way the number lessened as the population groups increased in size. Of the direct current, constant voltage dynamos, the larger cities reported the largest dynamo capacity. The dynamo capacity of the direct current constant amperage machines was almost uniform throughout all the population groups, while for the alternating and polyphase current machines the smaller places again had the highest horsepower capacity. There is no doubt that the stations located in the smaller places have a large amount of reserve machinery for use in case of accident, while in the larger cities the plants are larger and consequently do not require so large a numerical proportion of reserve machinery.

In Tables 89 and 90 are shown the effect of public arc lighting in the comparatively large number of direct current constant amperage machines in both the purely electric municipal stations and those operated in connection with other business, the totals for this class of dynamo being considerable.

Table 91 shows the dynamos in purely electric private stations, classified according to horsepower capacity of generating equipment. The very large proportion of dynamos found in the larger plants shows to what extent the current was being generated by a comparatively small number of stations. The 89 purely electric private stations with dynamo capacity of 2,000 or more horsepower reported a total of 590,229 horsepower, or more than half of the total for all the stations of this class. This condition is particularly striking in the alternating and polyphase dynamos, the capacity of these dynamos being 368,066 horsepower out of a total of 638,683 horsepower.

In the private stations operated in connection with other business a large proportion of the horsepower capacity is also found in the larger stations.

Substation equipment.—The early days of the electric lighting industry, like those of electric railways, knew nothing whatever of substations, and, indeed, had little or no necessity for that which has now become an important and vital adjunct for the distribution of current on the large scale required by modern operation. The original incandescent lighting system was of the direct current type, and was limited to a very restricted area, while the arc lighting circuit, also direct current, extended farther afield, although it did not embrace any larger area in its network of wires, but simply carried one single wire along a given thoroughfare and so continued, usually on some other street or streets, back to the generating plant. These conditions prevailed for several years, until the advent of alternating current on a practicable basis; although prior to that time attempts

BRUSH ARC LIGHTING GENERATORS, BUFFALO.

These arc lighting machines are driven in pairs by alternating current motors with current from Niagara Falls.

were made to increase the area covered from one station, chiefly by means of raising the voltage or pressure of the current at the central station. Even when the alternating current was introduced and the methods of its distribution were worked out, the substation did not immediately make its appearance, although rudimentary attempts in that direction were to be noted in the occasional grouping together of several transformers in what were known as "banks." These transformers receive the high voltage current and lower it in pressure for safer use on the consumption circuits, although they do not otherwise change the alternating character of the current.

While the single phase alternating current was shown to be available for incandescent lighting, and in some degree for arc lighting, it was, however, strictly limited to these two uses, not being available for stationary motors in general, for electric railway work, nor for storage batteries. Out of the necessities of electric traction, with its direct current motors, many of them operating several miles distant from the plant, arose the necessity for larger quantities of current deliverable at a high sustained voltage at remote points. Since it was inconvenient and expensive to have a number of scattered power plants for an electric railway system, the substation was evolved, the work done in alternating current power transmission assisting in the solution of the problem. These conditions will be dealt with in more detail historically in another chapter.

The substation, whether for electric lighting or for electric railway work, consists essentially of receiving or step-down transformers, to which the alternating polyphase current is brought by the distributing circuits at high voltage after being generated at the main power plant, which may be scores of miles away, but which in the average city system is usually from 5 to 15 miles distant. The step-down transformer lowering the voltage of the current delivers it to the rotary converter, a composite piece of dynamo electric apparatus, which, receiving it at one side or one end as alternating current, delivers it at the other end of the machine as direct current, either directly to the consumption circuits or to storage batteries. The current is stored wholly or in part. In a few instances in this country, and very generally in Europe, the substation apparatus that converts the alternating into direct current is not one machine with two commutators, i. e., a rotary converter, but is a "motor generator," or two distinct dynamo electric machines on one base. The alternating current motor in this combination is driven by the current received from the transformers and revolves, by direct connection on the same shaft, the armature of the generator that furnishes the direct current. This is, however, but a detail of operation.

General statistics of substation equipment.--The number and horsepower of transformers, storage battery cells, rotary converters, and miscellaneous equipment in substations were required to be reported separately. It should be understood that none of this apparatus is in addition to the capacity of the generating plant, but is simply required in order to render the current available to the consumer. Tables 75 and 85 present in detail this class of equipment in private and municipal stations, respectively, by states and territories. The totals are summarized in the following table:

TABLE 60.—*Substation equipment—private and municipal stations: 1902.*

KIND OF EQUIPMENT.	TOTAL.		PRIVATE STATIONS.		MUNICIPAL STATIONS.	
	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
Storage battery cells	8,388	25,284	8,388	25,284	.....	.....
Transformers	1,800	419,367	1,765	418,068	35	1,299
Rotary converters	169	109,556	168	109,546	1	10
Miscellaneous	140	21,443	135	21,269	5	174

Storage batteries.—It will be seen by the table that in substations there were 8,388 storage battery cells, with a capacity of 25,284 horsepower. All of these were reported as in substations, and the presumption is, therefore, that they were so located, although there were in addition 6,881 cells, with a nominal capacity of 16,355 horsepower, reported as performing a kindred function in the main power plants. This gives a total of 15,269 storage batteries, with a capacity of 41,639 horsepower. The capacity of storage batteries can not be taken absolutely, since the horsepower depends so largely upon the rate of discharge, but the figures here given are such as are justified by the reports from the central stations as to battery output of current, although it was not found feasible to reduce this to horsepower hours. All of these storage batteries were in private stations, there being none whatever in municipal stations except in New York, where 900 cells of 20 horsepower capacity were reported. While the storage battery equipment was in no sense an addition to the generating capacity of the main power plants, its employment virtually increased such capacity by enabling a station to supply for a given period more current than it could actually generate in the same time, although such a period would be relatively short, often not more than a few minutes.

By far the largest number of storage battery cells, 2,616, was returned for New York, but their capacity was reported as only 2,240 horsepower. The average capacity of these cells is small as compared with that of the 950 in California, with 2,333 horsepower; the 912 in Illinois, with 5,590 horsepower; the 866 in Massachusetts, with 5,200 horsepower; the 476 in Missouri, with 1,955 horsepower; and the 166 in Ohio, with 1,333 horsepower. The capacity differed very remarkably, as a result of the variations in the rate of discharge and the different methods of calculating the available capacity or output of cells.

Transformers.—There were 1,800 substation transformers, with a total of 419,367 horsepower, and of these only 35, with 1,299 horsepower, were in municipal substations.

The transformers in private substations numbered 1,765, with 418,068 horsepower. They were widely distributed. California reported 504, with 139,527 horsepower, and New York 424, with 133,249 horsepower. In none of the other states do the number and capacity call for particular notice. In some of the states the transformers in the substations delivered alternating current at the lower pressures directly to the consumption circuits, without rectifying it into direct current by means of rotary converters or motor generators.

Other apparatus.—There were 169 rotary converters with 109,556 horsepower, and all of these except one of 10 horsepower were reported by private stations. The miscellaneous equipment enumerated in the table comprised 140 pieces of apparatus, with 21,443 horsepower, of which all but 5, with 174 horsepower, were in private stations. This miscellaneous apparatus consisted chiefly of the motor generating sets already referred to or of boosters, a type of direct current apparatus employed to keep the voltage of current up to a given point at places where, because of the distance from the main station, it might fall below the desired pressure.

Most of the 168 rotary converters reported for private stations were in five states, namely, 74 in New York, with 80,884 horsepower capacity; 23 in Pennsylvania, with 4,286 horsepower; 19 in Illinois, with 5,470 horsepower; 12 in California, with 4,858 horsepower; and 11 in Minnesota, with 3,066 horsepower. The miscellaneous apparatus reported was also largely confined to these same states.

Table 85 for municipal stations includes very little substation apparatus and that almost entirely in the transformer class. The 35 transformers with 1,299 horsepower were distributed among 10 of the states, chiefly in California, Michigan, and Vermont.

In the main power plants no enumeration was made of raising transformers, employed for the purpose of receiving alternating current at low pressure immediately from the adjacent generator and raising or stepping-up its pressure for better transmission over long distance circuits. This class of apparatus would, therefore, appear to be limited to what are specifically power plants, as distinguished from regular electric lighting and power stations working at much lower voltages than those which have become common in purely power transmission enterprises.

II.

LINE CONSTRUCTION.

General discussion.—A leading element in central station work is that of line construction, comprising the circuits that stretch overhead or underground between the central station, its substations, and the scattered consumers in the territory served. It is somewhat difficult to cover this item in full detail, and very careful efforts were made to obtain accurate reports. A feeder wire is one leading from the generating plant to a point where it is connected with the main wires; these wires in turn lead to the service wires to which are attached the lamps, motors, etc., consuming the current. The mains and feeders, in most instances, are not ordinary wires, but large and substantial cables made up sometimes of several strands or conductors of copper and sometimes of massive copper rod.

Statistics and ownership of mains and feeders.—An attempt to enumerate the service wires would have led to inextricable confusion and to great uncertainty of results, as it might be questioned whether many companies have any accurate idea as to the miles of service wire to which their mains and feeders may be connected within buildings; hence, the inquiry was limited to mains and feeders, the totals being summarized in the following table:

TABLE 61.—*Miles of electric line construction—private and municipal stations, and percentage each class is of total: 1902.*

	Total.	Private stations.	Municipal stations.	PER CENT— In private stations.	PER CENT— In municipal stations.
Total:					
Mains	107,263.63	93,352.95	13,910.68	87.0	13.0
Feeders	17,880.51	16,452.28	1,428.23	92.0	8.0
Underground—					
Mains	5,847.71	5,408.55	439.16	92.5	7.5
Feeders	2,276.55	2,262.02	14.53	99.4	0.6
Overhead [1]—					
Mains	101,383.76	87,913.13	13,470.63	86.7	13.3
Feeders	15,592.59	14,181.75	1,410.84	91.0	9.0
Submarine—					
Mains	32.16	31.27	0.89	97.2	2.8
Feeders	11.37	8.51	2.86	74.8	25.2

[1] Includes 79.50 miles of mains and 120.25 miles of feeders for electric railway service owned by lighting company.

In this table the circuits are divided into three groups—overhead, underground, and submarine. With the overhead mains and feeders are included the circuits for electric railway service owned by lighting companies. Generally such wires are owned by the railway companies, and therefore the mileage for them embraced in this table is small. The underground conduits are frequently owned by the lighting companies, but there are some instances in which they are owned by a separate conduit company, as in New York, or by the municipality, as in Chicago. In these cases the lighting companies pay a rental for the use of the ducts through which their mains and feeders are drawn, and the amount paid out for this accommodation forms an important addition to the price that must be charged for the service in order to cover such items of expense. The special agents were required, therefore, to obtain a complete statement from lighting companies on these points, showing rental paid for conduits, and thus elicit the facts as to ownership.

There were 125,144.14 miles of mains and feeders reported for both private and municipal stations. Of this total 107,263.63 miles were returned as mains and 17,880.51 miles as feeders, the ratio being about 1 mile of feeder to 6 miles of main. Of the grand total 109,805.23 miles, or 87.7 per cent, were reported by private stations and 15,338.91 miles, or 12.3 per cent, by municipal stations. The mains and feeders for underground circuits measured 8,124.26 miles, or 6.5 per cent of the total, and the overhead circuits including 199.75 miles of mains and feeders for electric railway service owned by the central lighting stations, measured 116,976.35, or 93.5 per cent of the total.

Table 61 includes also the figures for both private and municipal stations, from which it will be seen that while the municipal stations had but 7.5 per cent of the underground mains and only six-tenths of 1 per cent of underground feeders, they had 13.3 per cent of the overhead mains and 9 per cent of the overhead feeders. It thus appears that it is the municipal, rather than the private, stations that have the larger proportion of overhead circuits to which such strenuous public exception is often taken, but, on the other hand, it must be borne in mind that nearly all of the municipal stations are in the smaller communities where the cost of underground work makes the use of the underground system impossible, and where, as a matter of fact, neither wires nor poles constitute a particular blemish to the landscape.

Line construction, by states and territories.—Tables 73 and 83 give details, by states and territories, as to the distribution of these main and feeder circuits for private and municipal stations, respectively. Of the 16,452.28 miles of feeders connected to private stations, 1,932.80 were in use in the state of New York and 2,949.28 miles in Pennsylvania. The mileage of the mains in New York and Pennsylvania did not differ greatly, being 11,139.17 miles in the former and 11,382.01 miles in the latter. In Massachusetts there were 962.38 miles of feeders and 11,415.55 miles of mains. In Illinois there were 876.68 miles of feeders and 5,374.80 miles of mains. Rhode Island ranked third in mileage of feeders, with 1,086 miles, but had only 2,593.50 miles of mains, the relative proportion of mains to feeders being extraordinarily small, or only 2 to 1, while the ratio for the whole country was about 6 to 1.

The relative extent of overhead and underground circuits in the different states varied, being determined somewhat by the practice in a few of the larger cities. Thus in New York there were 303.12 miles of feeders and 1,325.11 miles of mains in the underground circuits, while for Massachusetts there were reported only 17.55 miles of underground feeders and 1,657.83 miles of underground mains. In Pennsylvania, on the other hand, the amounts of the two underground varieties were more nearly equal, being 500 miles for feeders and 668.50 miles for mains. Pennsylvania was the state with the largest extent of overhead main and feeder circuits, namely, 2,424.28 miles of feeders and 10,699.51 miles of mains. New York came next as to overhead circuits with 1,626.78 miles of feeders and 9,769.06 miles of mains. It was closely followed by Massachusetts with 936.83 miles of feeders and 9,757.55 miles of mains. More than half of the states did not report any underground mains or feeders, but this fact is only confirmatory of the statement already made as to the limiting of underground work to the relatively few larger cities. Even the states enumerating underground work have, as will be seen from the table, very large amounts of overhead construction.

While the underground work of municipal stations was limited to five states it was found almost exclusively in Illinois and Michigan, the former having 367.50 miles of mains and 6.03 miles of feeders, and the latter having 49.16 miles of mains and 7.50 miles of feeders. These figures are large because of the municipal stations in Chicago and Detroit. Of the aggregate mileage for municipal stations, Michigan had the largest proportion, which was slightly more than that of Illinois. There were in Michigan 1,980.74 miles of mains and 140.34 miles of feeders, while in Illinois there were 1,990.75 miles of mains and 104.77 miles of feeders.

Very little submarine circuit was reported, there being 11.37 miles of feeders and 32.16 miles of mains. The largest item is that of the 18.1 miles for private stations in Illinois, the greatest part or all of which would probably be found employed at various points very close to the Chicago river.

III.

SERVICE LINE EQUIPMENT.

Transformers.—Between the power plant or the substation and the apparatus at the consumption points are frequently to be found either transformers or meters, or both. Where the current used is "direct," transformers are not necessary, but where the current delivered to the premises is of the alternating type a transformer is required, in order to bring the current pressure down to the point at which it can be conveniently and safely used. These transformers are sometimes located within the consumers' own premises, but quite frequently they are placed upon an adjacent pole, which thus serves as an embryo substation for the distribution of current not merely to one house but to a group of houses. These transformers range in size from those able to deliver current for 10 lamps to those which will receive and transform the current for scores of lamps and long circuits.

Transformers of private stations.—It will be seen from Table 75 that there were 179,300 transformers, with a total capacity of 820,968 horsepower, in use on consumers' circuits connected to private stations. This gives an average of 4.6 horsepower to the transformers, making the average capacity from 75 to 100 lights.

In the earlier stage of alternating current work, smaller transformers were in service quite generally, but of late years they have decreased in number, while the capacity of the newer ones has risen rapidly.

The statistics, by states, present some variations in this respect. The reports for New York, for example, showed 17,009 transformers with a capacity of 186,031 horsepower, or an average of more than 10 horsepower per transformer. In Kentucky, Pennsylvania, Texas, Rhode Island, and Colorado the average was below 3 horsepower per transformer, showing beyond question the continued use of a large number of the small sizes. In Illinois, Massachusetts, Ohio, and New Jersey the average horsepower per transformer was about 4. The use as indicated by these figures and others in the table of so many small transformers is regarded as a practice making against efficiency and economy, and the whole tendency of recent years has therefore been to adopt larger types, although where the circuits are widely distributed and the customers are few, the small transformer is an absolute necessity. The installation of more than 20 or 30 lights in an ordinary dwelling house would be unusually large, and the individual wants of many houses would be amply taken care of with a transformer of a single horsepower capacity.

Transformers of municipal stations.—It will be seen from Table 85 that the municipal stations reported that there were 28,070 transformers with 100,106 horsepower capacity on their consumers' circuits. The average per transformer was 3.6 horsepower and therefore was considerably less in most municipal stations than in the private stations. An inspection of the table, by states and territories, shows that the largest number of transformers was in Ohio, where the average capacity was slightly over 3 horsepower. The average in Michigan also was a little more than 3 horsepower, while that in Indiana was a little less. The average capacity of municipal transformers in many states was very low. For Colorado, the reports showed 60 transformers and only 84 horsepower; in New Hampshire, 35 with 75 horsepower; in Utah, 37 with 67 horsepower; and in West Virginia, 71 with 130 horsepower. These are states, however, in which the conditions would usually require scattered circuits and isolated points of consumption of small sizes, necessitating the use of smaller transformers.

Classification of meters.—Meters are employed for both the direct and alternating classes of current and are now in almost universal use, although it is still the practice in some communities to sell current on a flat basis, the number of lamps and an assumed number of hours of burning being used as criteria in fixing the amount of the monthly bill. It is not the custom to employ these meters in connection with arc lighting whether the lights are for street or for commercial purposes. For this investigation the meters were divided into two main classes—mechanical and chemical. The former is intended to cover all meters in which the current effects registration by actuating electro-mechanically an escapement or train of gear wheels. In the chemical class, once largely prevalent but now seldom used, a deposit of metal is usually effected on a small scale by the action of the current, and the amount of current used is ascertained by weighing month by month the metal deposited. The later indications are that some forms of chemical meters are coming into vogue again.

Table 62 shows the number of meters on consumers' circuits reported for all stations, and also the number and proportion of each kind of meter for private and municipal stations, respectively.

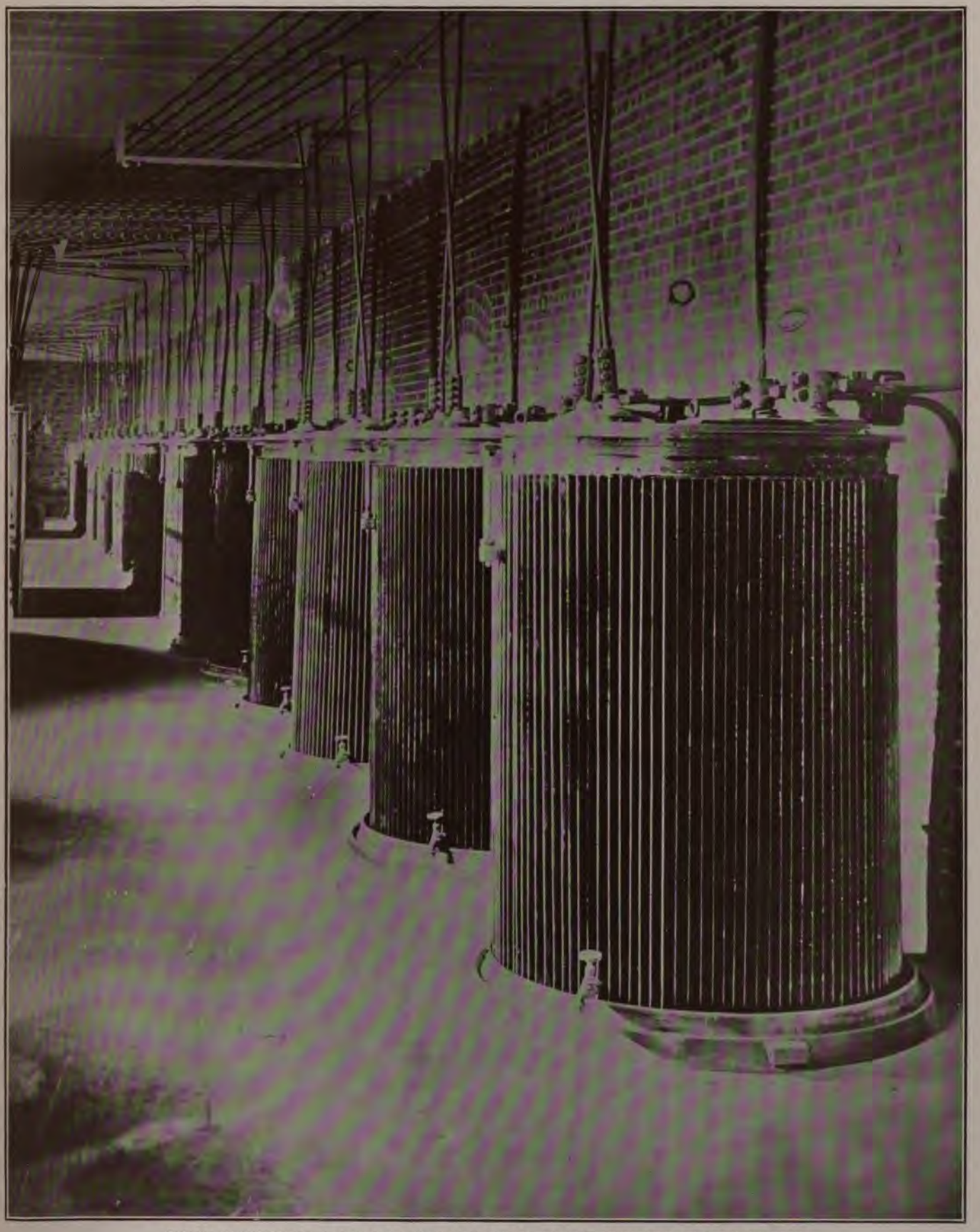
TABLE 62.—*Meters on consumers' circuits—private and municipal stations, and percentage each class is of total: 1902.*

KIND OF METER.	Total.	PRIVATE STATIONS.		MUNICIPAL STATIONS.	
		Number.	Per cent.	Number.	Per cent.
Total	582,689	526,011	90.3	56,678	9.7
Mechanical	575,004	518,428	90.2	56,576	9.8
Chemical	7,685	7,583	98.7	102	1.3

It will be seen from the table that the mechanical meters are in general use, inasmuch as 575,004 or 98.7 per cent of all meters in both private and municipal stations were mechanical and only 7,685 were chemical. The statistics for these meters are given, by states and territories, in Tables 75 and 85 for private and municipal stations, respectively.

Meters in private stations.—For private stations in New York 70,491 mechanical meters were reported, of which by far the largest number were in use in New York city. The New York Edison Company alone had some 30,000 customers in 1902–3, each of whom would be supplied with a meter. In fact, leaving arc lighting patrons out of consideration, a rough assumption not far from the truth might be made that each meter represented a customer, although in some cases a single consumer may use more than one meter when furnished with different classes of service. Pennsylvania reported 54,198 mechanical meters; Illinois, 53,584; Massachusetts, 52,137; California, 33,308; Ohio, 25,083; Michigan, 21,160; and New Jersey, 20,830. In most of these figures the influence of the larger centers of population with numerous customers is seen. The chemical meters connected to private stations were limited to 10 states, and were to be found almost entirely in Illinois, New York, and Pennsylvania, representing without question the chemical meters still employed by the Edison systems in the cities of Chicago, New York, and Philadelphia.

Meters in municipal stations.—The meters connected to municipal stations numbered 56,678, of which all but 102 were mechanical. The 102 chemical meters were



TYPICAL TRANSFORMER, SHOWING AN EQUIPMENT CONTAINING 22 TRANSFORMERS OF 150 K. W. EACH.

reported from one state, Indiana. The mechanical meters were widely distributed, the large numbers being found in the following states: Michigan, 7,712; Ohio, 6,001; Minnesota, 5,606; and Indiana, 5,603. The use of meters follows quite closely the distribution of incandescent lighting from municipal stations in the various states referred to.

Lighting apparatus.—At the time the statistics of the present report were compiled the apparatus attached to central stations for lighting purposes consisted broadly of two classes, namely, arc lamps and incandescent lamps.

General statistics of arc lamps.—Tables 76 and 86 show the number of arc lamps of each type, wired and ready to render service, for private and for municipal stations, respectively. The totals are summarized in Table 63, which also shows for each variety of lamps the proportion for both private and municipal stations.

TABLE 63.—*Number of arc lamps—private and municipal stations, and percentage each class is of total: 1902.*

CHARACTER OF SERVICE AND KIND OF LAMP.	Total.	PRIVATE STATIONS.		MUNICIPAL STATIONS.	
		Number.	Per cent.	Number.	Per cent.
Aggregate	385,698	334,903	86.8	50,795	13.2
Commercial or other private, total	173,973	168,180	96.7	5,793	3.3
Open	42,988	41,622	96.8	1,366	3.2
Inclosed	130,985	126,558	96.6	4,427	3.4
Direct current	104,176	101,849	97.8	2,327	2.2
Open	38,120	36,856	96.7	1,264	3.3
Inclosed	66,056	64,993	98.4	1,063	1.6
Alternating current	67,538	64,085	94.9	3,453	5.1
Open	3,733	3,631	97.3	102	2.7
Inclosed	63,805	60,454	94.7	3,351	5.3
All other	2,259	2,246	99.4	13	0.6
Open	1,135	1,135	100.0	.....	.....
Inclosed	1,124	1,111	98.8	13	1.2
Public, total	211,725	166,723	78.7	45,002	21.3
Open	138,684	108,082	77.9	30,602	22.1
Inclosed	73,041	58,641	80.3	14,400	19.7
Direct current	154,749	119,520	77.2	35,229	22.8
Open	125,298	96,659	77.1	28,639	22.9
Inclosed	29,451	22,861	77.6	6,590	22.4
Alternating current	48,063	38,316	79.7	9,747	20.3
Open	4,630	2,681	57.9	1,949	42.1
Inclosed	43,433	35,635	82.0	7,798	18.0
All other	8,913	8,887	99.7	26	0.3
Open	8,756	8,742	99.8	14	0.2
Inclosed	157	145	92.4	12	7.6

The aggregate of arc lamps of all classes was 385,698, of which 334,903, or 86.8 per cent, were operated from private stations and 50,795, or 13.2 per cent, from municipal stations. In addition to these 385,698 arc lamps connected to the circuits of central stations, the street railways operating electric lighting stations reported 33,863 arcs, making the total for the United States 419,561. This does not include, however, a large number of arcs operated in isolated plants of all kinds—a number which is estimated by some authorities to be almost equal to the number operated on central station circuits. As has already been pointed out in the discussion of income, the annual earnings of arc lighting by central stations were $27,408,708, giving an average of $65.33 per lamp, regardless of daily hours of burning. There were on an average about 155 lamps connected to each private station. The arc lamps connected or supplied by municipal stations averaged a little over 62 per station. As will be seen, however, there were comparatively few commercial lamps furnished by municipal stations, while the private stations did a large business of this character. Thus the private stations had connected to their circuits 168,180 commercial arcs and 166,723 public arcs, the business being very nearly equally divided. On the other hand, the municipal stations furnished only 5,793 commercial arcs, while they operated 45,002 public arcs. Altogether 173,973 arcs were for commercial service and 211,725 were for public service, the proportion being, respectively, 45.1 per cent and 54.9 per cent.

Classification of arc lamps.—The arc lamps are subdivided into those of the open type and those of the inclosed type, and also into those operated by direct current and those operated by alternating current. Until quite recently all the arc lamps in use in the country were of the open type, that is, they were inclosed by only one large globe. The characteristic of the inclosed type is the presence of a large outer globe and a small inner globe constituting a semivacuum immediately around the carbon sticks. Until recently this type was quite unknown in practical service, although it had been experimented with at the beginning of the industry. Since these statistics were compiled the tendency toward the production of inclosed arcs to the exclusion of the open arcs has been pronounced and intensified, and very few open arcs are now made. The transition was already so well marked in 1902 that 204,026, or 52.9 per cent, of the lamps in use were even then of the inclosed type, while 181,672, or 47.1 per cent, were of the open variety. While this change has been going on it has been accompanied by a corresponding resort to the alternating current for arc lighting work. Of the total number of arc lamps, 258,925 lamps, or 67.1 per cent, were operated by direct current, and 115,601, or 30 per cent, were operated by alternating current. It is interesting to note that while the inclosed lamps preponderated largely in commercial work, the open type was still signally in the majority for public lighting. Thus of the commercial lamps 130,985 were inclosed and 42,988 were open. On the other hand, 73,041 of the public lamps were inclosed and 138,684 were open. Of the arc lamps operated from stations controlled by electric railway companies 13,450 were of the open type and 20,413 of the inclosed.

It will be observed that a small number, 11,172, of all other lamps were returned, of which all but 1,281 were of the open type. These were difficult to classify, and probably under a strict classification all of them would have been returned as commercial lamps. They were not, however, used for illuminating purposes, according to the strict understanding of the word, but included a great many focusing and projector lamps used in theaters for stage projection purposes, in

photographic studios, engravers' shops, and in daily newspaper offices for the quick production of photographs, engravings, etc. These lamps would earn a larger income and in many instances would be much larger than the ordinary arc lamp, but it was deemed proper not to include them with arcs used strictly for illumination of buildings, streets, etc. A great many such special lamps were also employed on the circuits of isolated plants, but only those are included that were operated by central station circuits.

Arc lamps of private stations.—Table 76 shows, by states and territories, the number of arc lamps of each type connected to the circuits of private stations.

The proportions as to commercial and public lighting varied in the different states. In New York there were 30,608 public and 26,697 commercial lamps. In Pennsylvania there were 18,332 commercial and 25,851 public lamps. In Illinois, on account of the municipal stations in Chicago, the business was less evenly divided, there being only 9,636 public lamps, while the commercial lamps numbered 18,678, or nearly twice as many. In Massachusetts the numbers were almost equal, there being 14,658 public and 12,401 commercial lamps. No particular indication or information is derivable from these variations so far as individual states are concerned, and the conditions would doubtless be found to vary with individual stations rather than with territorial divisions, since so much depends upon the attitude of the management in any station with regard to particular branches of the business. In many of the larger cities the public arc lighting had diminished to a very small part of the business, and no particular activity was put into the canvass for commercial arc lighting. In other communities the arc lamp was held in special favor and its interests were pushed actively. It is to be further observed that in almost all of the states the direct current arc was in use, while the alternating current arc was less generally favored and, where in use, was very largely of the inclosed type, as, for example, in New York, Pennsylvania, Illinois, California, Massachusetts, and Ohio. The lamps classed in the "all other" group were limited to a few states, the principal ones being New York, California, New Jersey, Ohio, Pennsylvania, and Michigan.

Arc lamps of municipal stations.—The analysis of the 50,795 arc lamps reported by municipal stations is shown, by states and territories, in Table 86. There were 45,002 lamps used for public lighting and 5,793 for commercial lighting. The great proportion used for public lighting indicates how largely the municipal stations have adhered, so far as arc lighting is concerned, to their purpose of supplying public illumination to the disregard of commercial work. In fact, in several of the states no commercial arc lamps whatever were reported by the municipal stations, while in other states the number of such lamps was very small.

The fact that the arc lighting from private stations was done largely by inclosed arcs illustrates the rapid adoption of the latest improvements as well as an expensive discarding of old apparatus by such stations; on the other hand, the municipal stations experienced difficulty in adapting a public service plant to new conditions in an industry that was not yet well established as to its underlying technical conditions. When it is considered that such apparatus represents the investment of public money and is usually operated at a very low allowance for depreciation, as well as on a basis of return which frequently proves inadequate, it will be understood why in so many of the municipal stations the apparatus, whether for the production of current or for its consumption, remains antiquated. Of the 45,002 public lamps 30,602 were of the open type and 14,400 of the inclosed type. Of the lamps in Illinois only 1,427 were inclosed, while 8,361 were of the open type. In Michigan 2,202 were inclosed and 4,027 were of the open type.

Another illustration of the difficulty experienced by municipal stations in changing to more recent apparatus is furnished by the figures of the alternating current arcs, of which there were only 13,200, or a little over one-fourth of the total number for municipal stations, whereas the private stations reported 102,401 out of an aggregate of 334,903, or nearly one-third of the total. In several of the states, however, the change had already been made to a considerable extent, as, for example, in Tennessee out of 971 lamps 806 were of the alternating current type, and in Washington 897 out of 967 were alternating. These figures would appear to be due to the fact that the stations included were new and had been more recently equipped, thus affording the municipal plants the opportunity of starting out with apparatus of approved modern type.

Arc lamps of stations, classified according to population of places in which located and dynamo capacity.—Tables 87 to 90 show the statistics of arc lamps in stations, classified according to population of places in which located. In the purely electric private stations the number of lamps increases as the population groups increase in size. Of those used for commercial lighting almost three-fourths were of the inclosed type, while of those used for public lighting almost two-thirds were of the open type. These figures bring out rather forcibly the slow changes in public property and the practice of the private stations to keep up with the times. The same general conclusions are drawn from Tables 88, 89, and 90.

In Tables 91 to 94 are given the number of lamps in stations, classified according to the horsepower capacity of dynamos. Of the arc lamps in purely electric private stations almost one-half were connected with stations having a dynamo capacity of 5,000 horsepower and over. In the municipal stations nearly all the lamps were found connected to the small stations.

General statistics of incandescent lamps.—The most

MODERN METHODS OF STREET LIGHTING, BOSTON, MASSACHUSETTS.

In this engraving open and inclosed arc lamps are shown side by side on different types of poles.

METHOD OF LIGHTING FIFTH AVENUE, NEW YORK CITY.

In this view, near the Waldorf-Astoria Hotel, New York city, direct current multiple inclosed arc lamps are shown, two on each post, and directly connected by underground circuits with the mains and feeders which also serve current to residences.

productive source of income for American central stations is the furnishing of current for incandescent lighting. In preceding tables it was shown that out of a total income of $85,700,605, incandescent lighting amounted to $44,657,102, or 52.1 per cent. For private stations the rate was 52.5 per cent, and for municipal stations 48.2 per cent. This income was earned by a total of 18,194,044 incandescent lamps. This total may be accepted as a close approximation to the actual number of lamps wired and ready for use at the end of the year covered by this report. The central station industry of the country, so far as service for incandescent lamps is concerned, is now very largely on a meter basis, and this renders it difficult to secure a record of the actual number of incandescent lamps in service. In many cases the numbers reported, therefore, were estimates, but these estimates would not vary widely from the actual numbers, and would be rather an understatement than an exaggeration. Table 64 gives a summary of the totals for the United States and shows the proportions of incandescent lamps connected to private and to municipal stations.

TABLE 64.—*Number of incandescent lamps—private and municipal stations, and percentage each class is of total: 1902.*

CHARACTER OF SERVICE AND KIND OF LAMP.	Total.	PRIVATE STATIONS.		MUNICIPAL STATIONS.	
		Number.	Per cent.	Number.	Per cent.
Aggregate	18,194,044	16,616,593	91.3	1,577,451	8.7
Commercial or other private, total	17,738,384	16,243,853	91.6	1,494,531	8.4
16 candlepower	15,261,067	13,890,281	91.0	1,370,786	9.0
32 candlepower	514,679	484,246	94.1	30,433	5.9
All other candlepower	1,962,638	1,869,326	95.2	93,312	4.8
Public, total	455,660	372,740	81.8	82,920	18.2
16 candlepower	296,776	235,842	79.5	60,934	20.5
32 candlepower	59,988	47,063	78.5	12,925	21.5
All other candlepower	98,896	89,835	90.8	9,061	9.2

Of the total number of incandescent lamps of all varieties 16,616,593, or 91.3 per cent, were reported for stations under private ownership, and 1,577,451, or 8.7 per cent, were reported on the circuits of the municipal stations. Of the lamps connected to private stations 16,243,853, or 97.8 per cent, were employed in commercial lighting and 372,740, or 2.2 per cent, in public lighting. Of the 1,577,451 lamps reported for municipal stations 1,494,531, or 94.7 per cent, were employed in commercial lighting and only 82,920, or 5.3 per cent, in lighting streets, parks, public buildings, etc. The earlier municipal stations were started primarily with the object of furnishing arc lighting for street illumination, but these figures show the remarkable extent to which a deviation has been made from the original purpose. It is also deserving of notice that of the 455,660 lamps in public use 296,776, or nearly two-thirds, were of 16 candlepower and 59,988 were of 32 candlepower. While the great majority of 32-candlepower lamps were undoubtedly in use for street lighting it would appear that a very large proportion of the 16-candlepower lamps were in use for purposes other than out-of-door work.

The lamps of all other candlepower, 2,061,534 in number, comprise small lamps of from 4 to 8 candlepower, chiefly for advertising and decorative purposes, and a comparatively small number of lamps of high candlepower, such as 50 candlepower. In addition to all these lights, there were connected to the electric light and power stations operated by street railways a total of 1,442,685 incandescent lamps, of which 1,423,659 were in commercial use and 19,026 were employed for public lighting. The large majority of these, 1,326,368, were of 16 candlepower.

Incandescent lamps of private stations.—The private stations reported an aggregate of 16,616,593 incandescent lamps, of which 13,890,281 in commercial or other private use, and 235,842 in public use were of the 16-candlepower type. Exact figures were not obtainable on the point, but it is considered by many authorities that aside from decorative lamps there is a steady diminution in the demand for those of other candlepowers, such as 32 and 50, leaving the 16 candlepower as the unit of almost universal adoption and employment. In this connection it may be noted that in Europe, while the 16-candlepower lamp is well known and in widespread use, lamps of from 8 to 10 candlepower are largely employed—to such an extent, indeed, that it is still a common practice to estimate lighting capacity on the basis of 8-candlepower lamps. Throughout the United States, however, the 16-candlepower lamp is universally acknowledged as the standard, and it is questioned whether any of smaller candlepower are in regular commercial or public use for lighting purposes. None were disclosed by this investigation.

Of the 13,890,281 16-candlepower lamps in commercial use, 2,230,905, or almost a sixth, were in use in New York. The next largest number was 1,431,129 in Pennsylvania, followed by 1,377,619 in Illinois and 1,286,837 in Massachusetts. Other large figures were 921,136 in California, 527,422 in New Jersey, 720,162 in Ohio, 500,566 in Missouri, 476,074 in Michigan, and 451,928 in Indiana.

The effect can be traced in these figures generally, of the large centers of population, such as New York, Philadelphia, Chicago, Boston, Detroit, Cleveland, and Cincinnati. Incandescent lamps were to be found in every state of the Union, but, in spite of their wide distribution, very few were reported for some localities. Thus only 7,871 16-candlepower lamps were reported for Nevada, 12,498 for Indian Territory, 17,896 for Wyoming, 18,233 for Oklahoma, and 21,722 for New Mexico.

The public incandescent lamps of 16 candlepower were also widely distributed, but numbered only 235,842.

Of these 93,229, or more than one-third, were in New York, 17,299 in Illinois, 15,520 in Ohio, 14,031 in Pennsylvania, and 10,345 in California.

The number of 32-candlepower lamps in use with private stations was 531,309, of which 484,246 were commercial and 47,063, public. Of the commercial lights of this size, 173,232, or slightly more than one-third, were in New York state. This number was strikingly larger than that reported for any other state. The figures for New Jersey were 58,316 and those for Pennsylvania, 41,867. These three states accounted for 273,415 lamps. In some states very few lamps of this size were in use, either for commercial or public purposes; while in some other states their use in proportion to the total number of incandescent lamps was much more marked. Thus, in Indiana, out of a total of 522,118 incandescent lamps, 8,437 were of 32 candlepower, but in Iowa, out of 343,346, no fewer than 17,266 were of that capacity.

With regard to lamps of all other candlepower, of which there were 1,869,326 in commercial use and 89,835 in public use, the number in New York state was greater than that in any other state. In fact, out of the total of 1,959,161 for the United States, 1,140,769, or nearly two-thirds, were in New York. The next largest number reported, 239,784, was for Pennsylvania, but in no other state did the total reach 100,000.

Incandescent lamps of municipal stations.—Table 86 gives an analysis of incandescent lighting from municipal stations, by states and territories. It has already been pointed out that with the municipal stations incandescent lighting service is far more general than has been supposed. Of 815 municipal stations, 602 reported incandescent lighting for public purposes and 732, for commercial purposes. There was a total of 1,577,451 incandescent lamps connected to the municipal stations. Of these lamps, 1,431,720 were of the 16-candlepower type, 1,370,786 being commercial and 60,934, public. These lamps were so widely distributed that no very large numbers were reported from any state.

Of the 43,358 lamps of 32 candlepower, 30,433 were commercial and 12,925, public. A very large proportion was reported from Michigan, namely, 5,689 commercial and 614 public, Iowa coming next with 4,767 and 1,483, respectively. The totals in Illinois were 2,002 commercial and 2,119 public, and in Minnesota, 2,911 and 1,116, respectively. As to the lamps of all other candlepower, out of a total 93,312 commercial and 9,061 public, a very large proportion was again reported for Michigan, namely, 25,796 commercial and 290 public. Of both the 32 candlepower and the all other candlepower classes, Massachusetts reported very few commercial lights, but in public lighting the conditions were reversed, there being 1,207 public lamps of 32 candlepower and 1,543 of all other candlepower—presumably 50 candlepower. In many of the states no lamps of the "all other" class were in use, and in many other states the numbers were quite insignificant.

Incandescent lamps of stations, classified according to population of places in which located.—In Tables 87 to 90 are shown the number of the different varieties of incandescent lamps connected to central stations, classified according to the population of the places in which they are located. These tables show the comparatively large proportion of these lamps in the small towns and cities. Thus in the purely electric private stations 2,383,717 lamps out of a total of 11,463,050 were in places of less than 5,000 inhabitants, while in the stations operated in connection with other business this group had one-fifth of the total.

Use of stationary motors.—The third great class of apparatus to which electric current is now supplied is that of the stationary power motors, which were reported separately in the schedule of 1902. Stationary motors include all power motors that are permanently located at one point, as distinguished from electric railway motors on cars.

In the compilation of these statistics it was the intention to exclude all motors used for the operation of fans, since they are extremely small, averaging perhaps a tenth of a horsepower, but it is probable that some of these fan motors were included in the returns. Stationary motors are used for a great variety of work, and range in capacity from a fraction of a horsepower to several hundred horsepower. Some of the motors furnish power for the operation of ventilators, elevators, hoisting apparatus, machines, etc. In some instances the motors are attached to a line shaft, and drive the machinery of whole floors of a factory or a machine shop, while in other instances they are connected to single and separate appliances. It would be hard to mention a trade in which motive power is used, for which part of the motive power is not now supplied by electricity.

At the outset of the industry, none of the central stations carried motors on the circuits. Then a few of the series type were introduced on the high potential arc lighting circuits, and one or two power companies were formed which put in operation low voltage direct current motors in parallel, and endeavored to build up a business simply and solely on the power basis. When it was demonstrated that these low voltage parallel motors were a success, and it was shown that they could be operated on incandescent lighting circuits without causing serious fluctuations in the current supplied to the lights, the central stations with incandescent lighting circuits took them up eagerly, so that in 1902 virtually the whole of the stationary motor business of central stations was being done with low voltage incandescent lighting, 110 to 250 volt circuits, or on a few special power circuits with direct current of a pressure not exceeding 500 volts. In other words the old series motors on the arc lighting

circuits had almost entirely disappeared, and it was difficult to locate any of them, although it was understood that a few were still in use in one or two places.

General statistics of stationary motors.—As will be seen from Tables 76 and 86 there were connected to the central stations of the country 101,064 stationary motors, of a total capacity of 438,005 horsepower. Of these, 99,102, with a capacity of 434,681 horsepower, were reported as being in operation in connection with private stations, and 1,962, with a capacity of 3,324 horsepower, were reported as being in operation in connection with municipal stations. It was exceedingly difficult to ascertain the number of motors on the circuits, but careful estimates were obtained for each station, and the number and horsepower capacity given may be accepted as closely approximating the facts. Incidentally it may be noted that the number of railway cars served was 2,379, of which number all but 9 were reported by private stations.

Motors of private stations.—As shown by Table 76, which gives the figures, by states and territories, for private stations, the motors were quite generally distributed throughout the country, although a large proportion was limited to a few leading states. Thus New York reported 13,557 motors, with 109,195 horsepower. This number was exceeded in Pennsylvania, where there were 14,128 motors, but in this state the total capacity was very much less, being only 30,536 horsepower. In Illinois there were 11,828 motors, with 35,910 horsepower; in Massachusetts, 9,621, with 35,565 horsepower; in Ohio, 5,535, with 21,657 horsepower; in California, 5,112, with 49,856 horsepower; in Missouri, 4,552, with 14,411 horsepower; in New Jersey, 2,209, with 9,245 horsepower; in Indiana, 2,267, with 5,550 horsepower; and in Minnesota, 1,826, with 9,331 horsepower. It will be seen that the horsepower capacity of motors varied widely. Of the states having a large number of motors, the average capacity of between 9 and 10 horsepower, which was found in California, was the highest, although the motors in New York were not much smaller, having about 8 horsepower each. In Ohio the average was about 4 horsepower; in Illinois, 3 horsepower; and in Pennsylvania, 2 horsepower. As for the railway cars operating, by far the largest number, 919, was reported for Pennsylvania, other large numbers being 231 in California, 219 in Massachusetts, 180 in Illinois, and 131 in Ohio.

Motors of municipal stations.—Table 86 gives an analysis of the motor service of the municipal stations, by states and territories. As already noted, the number of motors was only 1,962, and the total capacity 3,324 horsepower. As a matter of fact, only 118 out of the 815 municipal stations were engaged in this class of work. The largest number of motors, namely, 364, was reported from Indiana, but the capacity of these motors was only 103 horsepower, the average being less than one-third of 1 horsepower each. In Louisiana there were 246 motors, but the total capacity was given as only 34 horsepower, which would lead one to infer that some of the motors were of the fan type. On the other hand, there were 232 motors, with 464 horsepower, in Michigan; 169 motors, with 299 horsepower, in Ohio; 78 motors, with 440 horsepower, in California; and 137 motors, with 280 horsepower, in Texas.

CHAPTER VI.

OUTPUT OF STATIONS.

Measurement of output.—The main function for which a central station exists is the generation of current, all other business being incidental. The electric light and power company may be regarded by itself and by the public as a merchant of illumination, and in the earlier days of the industry it was the policy as well as the practice of stations to limit themselves to the operation of arc and incandescent lamps and to reckon their income upon an arbitrary basis of a flat rate for the supplying of so many lamps for the day, week, month, or year. The larger stations, however, shifted rapidly and the smaller ones more slowly to the practice of computing their income and expenses on the basis of the generating output, and a very large proportion of the income dealt with in this report, while still related specifically to the number of arc and incandescent lamps or motors supplied, is computed and analyzed by the stations themselves on the unit of kilowatt hour output. The kilowatt hour is the unit now in universal acceptance and is 1,000 watts of current supplied for an hour. There are 746 watts in the old familiar horsepower, so that a kilowatt is about 1⅓ horsepower.

Some of the larger stations attempt with appropriate instruments of large caliber the exact measurement of all the current leaving their generating plants at every hour of the day and night. Others do not measure all the current, but base estimates of output upon occasional readings at the switchboard of volts and amperes and watts, or figure out the known consumption capacity of the apparatus supplied with current.

The fact that the current for arc lighting is not usually metered necessitated computations for a great many stations, but there are familiar units for such purposes, and a standard arc lamp is accepted as consuming from 450 to 550 watts per hour. In like manner it was necessary to estimate the consumption for many of the incandescent lamps, but this is a relatively easy process on the basis of an average consumption of 3.1 watts per candlepower per hour for ordinary standard incandescent lamps of 16 candlepower.

Loss of current in transmission.—It is needless to say that there is, and always will be, a certain difference between the output of current recorded on the station instruments and the consumption as indicated by the sales, and it is the steady endeavor of the station managements to determine and locate such intermediate loss so far as possible.

There must always be a certain "line" loss from the resistance of the circuits and from leakage, as well as a further unavoidable loss in such apparatus as transformers, meters, etc. The figures as to this lost and unaccounted for current vary greatly and for different reasons. An interesting discussion of the subject may be found in the proceedings of the twenty-seventh convention of the National Electric Light Association, in 1904. In one instance cited in the discussion, the sale of current supplied over a certain feeder amounted to 83.5 per cent of the output furnished by the station to that feeder, the current lost or unaccounted for being 5.22 per cent, and the total lost and unaccounted for being 16.5 per cent. This would probably be a low figure of loss, and the percentages would run, in many instances, considerably higher.

Cases are on record where the loss of current has been due to actual theft, whether by means of concealed shunting of a part of the current, by tampering with the meters, or by overloading apparatus furnished with current at a flat rate, as, for example, in giving a 5-horsepower motor 10-horsepower work to do. In some of the states special legislation has been invoked to prevent the theft of current.

Reference is made to these points in order that it may not be supposed that the output of stations given herewith can be taken as more than a careful attempt to approximate the output upon which the earnings were predicated or reported; while the difference between the output reported and the current actually found available for sale would in many instances go far to account for high rates associated with a small income.

Irregularity of demand for output.—In many of the stations the apparatus is in full operation during only a small part of the day, on the average, and a great deal of it stands idle for some hours. It is obvious that the output of current on Sundays would fall below the average of other days for large groups of apparatus, such as power motors in factories and incandescent lights in offices. On the other hand, however, the public and many of the commercial arc lighting circuits remain in full operation on Sundays and a large output of current is often called for on special occasions, such as the Christmas holiday week, when many plants are driven so far beyond their capacity that they then reach the highest "peaks" in their load and have to put in operation every piece of available machinery.

Very few, if any, plants are in operation to their full capacity every hour of the day, although at certain hours certain portions of the generating plant are run the full capacity. Thus the arc lighting circuits are fully occupied during certain hours of the night, and some of them all night. The incandescent lighting machines

FIXTURE AT SOUTHERN TIP OF MANHATTAN ISLAND, CONSTITUTING AT ONCE A LAND LIGHT AND A BEACON.

are in use a certain number of hours nightly with varying output, largest in the earlier hours of the evening, and with occasional fluctuations, tapering off toward midnight. The machinery particularly devoted to the production of current for electric motors has the greatest demand upon it during factory hours, and apparatus supplying current for all of these purposes in the larger plants is operated continuously except with occasional intermissions for inspection or possible repairs.

Average output.—The figures given in Tables 75 and 85 may be accepted as a fair approximation to the actual work done by the stations enumerated in this report. According to these tables the average kilowatt hour output of current per day for all stations was 6,960,783, and the total for the year was 2,507,051,115. The stations operated under private ownership reported 2,311,146,676 kilowatt hours, or 92.2 per cent of the output, and those under municipal control 195,904,439 kilowatt hours, or only 7.8 per cent. Translating the kilowatt hours into horsepower hours the average output of current per day was 9,294,456, and the total for the year was 3,341,943,090 horsepower. According to other tables in this bulletin, the total dynamo capacity of central stations was 1,624,980 horsepower or about 1,200,000 kilowatts. As the average kilowatt hour output of current per day is shown to have been 6,960,783, or just short of 7,000,000, it would appear from this that the electric lighting stations in 1902 were on a basis of daily average operation of six hours, or, putting it in another way, approximately 25 per cent of their possible capacity of production of current per day was used.

Average earnings per kilowatt hour.—Since the earnings from the sale of current were $84,186,605 for the year, as shown by Table 1, upon the basis of output quoted above, the 2,507,051,115 kilowatt hours would appear to have earned on an average a little over 3⅓ cents per kilowatt hour. As has been explained, this return per unit can not be taken as exact, but would depend on the varying losses occurring between the generator and switchboard in the central station and the consumers' lamps and motors.

Another way of stating the result from operation and output would be to take the 1,200,000 kilowatt capacity of dynamos and divide it into the earnings from sale of current, which would give an average of $70 per year per kilowatt of capacity; this yielding also an output of almost exactly 2,100 kilowatts per year per kilowatt of capacity. As shown by the tables, however, there were extreme variations from this figure.

Output of private stations, by states and territories.—Table 75 presents, by states and territories, the output of private stations in kilowatt hours and horsepower for the year, and also the average per day. It will be necessary, however, to refer only to the kilowatt hours, as the conversion to the other unit can be readily ascertained by reference to the table. Of the totals reported New York was decidedly at the head of the list, with 695,017,187 kilowatt hours, or not far from one-third of the total for the whole country. To account for the position of New York as a consumer of current upon a vast scale there is not only the enormous consumption area with dense population in and around Manhattan Island, but there are also the gigantic generating plants at Niagara Falls, which accounted for more than 400,000,000 kilowatt hours. Reference to Table 6 shows that New York city alone had an output of 153,288,077 kilowatt hours, or a little over one-fifth of the total for the whole state, and about one-fifteenth of that for the whole country. In the other states the output followed closely the lines of generating capacity and consumption apparatus referred to in the discussion of other tables. The leading states were as follows: Pennsylvania, California, Illinois, Massachusetts, and Ohio. The chief cities in each of these states accounted for very large proportions of this output. Thus in Illinois the output for Chicago was 67,479,260, or over one-half of the total for the state. In California, San Francisco had an output of 55,046,745 kilowatt hours, or slightly less than one-half of the total for the state. In Massachusetts, Boston reported 52,037,255 kilowatt hours, or not far short of one-half of the total for the state. These large proportions were not found in all of the states, although the urban population still remained the largest consumers. In Ohio, for example, Cincinnati reported but one-sixth of the total for the state, but there was nearly as large a consumption also in Cleveland. In Pennsylvania, Philadelphia reported 54,089,356 kilowatt hours, which was about one-quarter of the total, a ratio corresponding with that of New York city to New York state. The consumption of current in most of the Southern states was quite small, but reached large proportions in Missouri, with 49,756,499 kilowatt hours, and Texas, with 46,210,310. Because of the large water-power production already noted the total in South Carolina, not including the stations operated by street railways, ran up to 16,573,550.

Output of municipal stations, by states and territories.—Table 85 gives the output of current in kilowatt hours and horsepower hours for the municipal stations. The total number of kilowatt hours for the year was 195,904,439. The largest output for any state was that for Illinois, where there was a production of 27,660,979 kilowatt hours. Ohio followed closely with 25,900,884. In Michigan the output was 22,889,897, and in Indiana, 18,625,210. The only other states with relatively large production of current were Minnesota, with 11,113,815 kilowatt hours and Pennsylvania, with 11,023,619. The amounts for some of the states were quite trivial, averaging, for example, 254 kilowatt hours per day in both Colorado and Utah. In Rhode Island the output was only 315 kilowatt hours per day; in Idaho, 646; in Oklahoma, 592; and in New Hampshire, 888. Economical production of current under any régime would appear to be simply impossible upon so restricted a basis as this.

CHAPTER VII.

FRANCHISES.

The subject of franchises, with the allied topics of public regulation and public ownership, has been discussed very extensively in the Report on Street and Electric Railways. In most of the states the conditions under which franchises are granted for electric lighting plants are governed by the general laws that apply to street railways and to other public service corporations. Reference may therefore be made with profit to Chapter IX of the special report of the Census Bureau on Street and Electric Railways, since it appears unnecessary to go over the same ground again with corresponding minuteness of detail.

The granting of charters and franchises.—Electric lighting, street railway, and other analogous corporations derive their charters, which give them the right to exist and which regulate in a general way their internal government, from the state through the medium of either a general or a special statute. Usually further definite authorization is necessary before wires may be run along a specific street or highway, and it is this authorization that is designated by the term "franchise" in the more limited sense. By some state constitutions the legislatures are strictly prohibited from granting any use of streets or highways without the consent of the local authorities; and in nearly all the states where this express provision is not found the practice of legislatures is to leave to the local governing body an effective control in this matter. This control ordinarily involves and implies the right of local authorities to impose such conditions as they may see fit at the time the franchise is granted, and these conditions are endless in their variations; sometimes they have been found later to conflict with constitutional requirements, and often it is alleged that they either inflict hardship on the company or make undue concessions to the corporate body in interest, with consequent loss to the community.

It is a truism that virtually the whole of the urban population of the United States lives under the operation of franchises of one kind or another, and that the public welfare is intimately affected by their terms.

Tendency toward combination.—During the later years in the evolution of corporations one of the most pronounced features affecting franchises has been the tendency toward combination, which excludes the assumed benefits of competition and creates under one régime in any city the monopoly or concentrated management of illumination, traction, telephone service, gas supply, and other necessities. The actual effects of combination upon the community continue to be warmly discussed and disputed, and in some instances, in order to avoid dealing with private corporations, the local authorities themselves have undertaken the operation of productive industries as business enterprises.

Municipal ownership.—Discussing this point, Hon. T. M. Cooley says: "The supplying of public conveniences to a city is usually a monopoly, and the protection of the public against excessive charges is to be found first in the municipal power of control. Except in the large cities public policy requires that for supplying light and water there should be one corporation, because one can perform the service at lower rates than two or more, and in the long run will be sure to do so. In some kinds of business competition will keep corporations within bounds in their charges, in others it will not." The broad recognition of this theory or conviction is found in modern franchise practice, which very rarely opposes the carrying into effect of such corporate consolidation, and seeks rather to safeguard the interests of the public by exercising regulation through a board of control. Massachusetts furnishes the best example of such a board, and its regulations will be referred to in detail.

As a matter of fact, all the corporations working under franchises may be said to be more or less strictly accountable to public opinion by resting under the menace of municipal ownership in case the service rendered should be found indifferent and the rates charged should be regarded as exorbitant.

There is a leading opinion by a Massachusetts court in which the majority of justices affirm that the sale of coal and wood is not a public purpose, and that cities and towns could not be authorized by the legislature to open municipal fuel yards.[1] At the same time Massachusetts is the state in which municipal ownership of lighting plants has been most liberally extended, on the broad ground that whatever is of general utility or convenience to any community constitutes a public purpose. The court applies this principle to the manufacture and sale of gas and electric light, on the basis of general convenience of service, the impracticability of each individual rendering the service for himself, and the necessity for using the streets in a special way or of

[1] Opinion of Justices, 155 Mass., 601.

exercising the right of eminent domain. Elsewhere also the furnishing of electric light, heat, and power has been very generally held to be a public purpose, and a proper subject of municipal ownership.

Regulations in various states.—In Ohio the law permits any city or town to buy gas works whenever the council deems it expedient, and this has been treated as including electric light plants. In Iowa a city or town may purchase, establish, or operate electric light and power plants, and also may grant to an individual or corporation the authority to erect or maintain such works for a term not exceeding twenty-five years. No exclusive franchise is to be granted and no plant can be authorized, leased, sold, etc., and no franchise can be changed without a favorable vote of a majority of the electors. Under these provisions it has been held that a municipality may supply its inhabitants with light or water by a plant of its own, even if a franchise for exactly the same purpose has already been granted by the municipality to a private company. In South Carolina, under the constitution of 1895, any city or town, by vote of a majority of its electors, may build or buy waterworks or lighting plants for the supplying of its inhabitants. The same privilege applies in Kansas, under the laws of 1897, and in Missouri. In California municipalities of certain classes, that is, those with a population of 10,000 or less, may purchase, lease, or construct electric light works. The Indiana statutes of 1896 provide "that in cities of a population of 3,500 or more the city authorities may purchase, erect, or operate electric light plants." Under the Maine statutes of 1894 corporations must obtain a franchise for electric lighting plants and make just compensation, and at the end of every franchise period of five years the council may, on a two-thirds vote of the electors, buy, at eminent domain value, and operate electric light, heat, and power plants. In Washington, under the statute of 1897, any incorporated city or town may own and operate electric light plants for the service of both the city and its inhabitants, but a referendum is necessary, and if debt is to be incurred the proposition requires a three-fifths vote at the polls. In Wisconsin any city or village may buy, build, or operate lighting plants for street service.

General statistics.—The general charter and franchise conditions affecting the private electric light and power stations, as embraced in this report, show that 1,573 operated under charter; 300, under special acts of legislature; 2,988, under municipal ordinance; and 173, under other authority. Frequently a station has been granted more than one charter or franchise. The franchise conditions were varied and of wide range. Thus the reports show that exclusive franchises had been granted to 938 of these stations, competitive franchises to 2,398, limited franchises to 1,712, and unlimited franchises to 1,629. These figures should be taken as merely indicating the trend of matters. A number of stations were operated where no authority was ever secured. For example, in a village an individual may have put up poles and strung the wires with the consent of all, or, at least, with no one objecting. Moreover, in some of the largest cities, important systems were being operated without specific franchise conditions. Accordingly, many of the stations filed no answers to the inquiries, while others, it was manifest, answered them incorrectly. Therefore, these figures are not exactly harmonious; yet while they are unsatisfactory they may be taken for what they are worth and as an indication of the general status. In 10 of the states and territories no free service was required, but in no fewer than 35 a cash compensation was required and paid outside of taxes. The amount of cash compensation paid yearly was returned as $199,423, and the amount of free service required was valued at $150,809. These amounts are very small, but the aggregate amount paid in taxes is large, and yet it is probable that all the items for taxes were not included, as there are so many aspects under which a central station may be liable to assessment and taxation. For private stations the taxes reported amounted to $2,654,885 and constituted a large proportion of the $11,456,037 paid out for miscellaneous expenses. For municipal stations the taxes amounted to $10,120. As an example of taxation, it may be cited that the Boston Edison Company was assessed in 1902–3 on a valuation of $9,844,000 and in 1903–4 paid taxes of $163,082 upon a valuation of $10,729,100.

Duration of contract.—Other conditions that would have been of interest are necessarily omitted on account of the insuperable difficulties encountered in securing full information. One of these points, for example, is that of the duration of the contract or franchise. While the franchise may run indefinitely, the contract for street lighting under it may be of brief duration and frequent renewal may be necessary. The best interests of the community are, however, very often served by effecting long contracts, since lower rates can be secured under a long contract than under a contract made for a short period and therefore more uncertain of tenure and renewal. In some cities the contracts have been made in recent years for long periods; for example, in Boston the contract was for ten years, subject to five-year periods of review, and in Baltimore and other cities contracts were for five years. The charter of Greater New York, however, forbids the making of a contract with the franchise corporations for a longer period than one year, and it is contended by the corporations that this is one of the leading reasons why the apparent cost of street lamps is higher in New York than in some other American cities.

Variety of franchises.—Another feature that necessarily escapes consideration is such data as the variety of franchises that may exist in states where the franchises granted prior to the enactment of uniform laws as to franchises were of a heterogeneous character.

Thus in Kentucky 14 of the franchises were reported as being unlimited, whereas the Kentucky constitution of 1891 provides that with regard to electric light and other public service corporations building in any town or city the municipal franchise shall not exceed twenty years. In Iowa the franchise term under the constitution is not to exceed twenty-five years, nor is it to be exclusive; yet 79 stations in that state reported exclusive electric light franchises and 40 reported franchises that were unlimited. In Indiana, according to the statutes of 1896, the franchise periods are not to be of a longer term than twenty-five years; yet 68 franchises in that state were reported as being unlimited.

Charters and franchises in Illinois.—An examination of 128 of the schedules returned for Illinois shows that 48 of the companies reported charters and 2 reported that they had been incorporated under special acts of the legislature. Five were incorporated under the act of 1872. As to franchises, 1 reported a county franchise and all but 3 had municipal franchises; 1 had no authority or right, but had a city contract. One had only a permit to "connect wires to consumers." Exclusive franchises were reported by 11; 21 reported unlimited or perpetual franchises; 99, franchises of ten years and longer; 3, franchises limited to five years; 1, a franchise for one year; and 1, a permit that could be canceled at any time. Twenty-one of the companies reported compulsory free lighting, usually of the city hall, the fire engine houses, the waterworks, and other public buildings. One reported the free lighting of the public library, but this was not compulsory. In Chicago 2 of the stations were required, after five years' operation, to pay the city 4 and 3 per cent, respectively, of the gross revenue. It was reported that one city reserved the use of the poles for fire alarm purposes, but this requirement is undoubtedly much more general, the probability being that many of the stations simply omitted to mention the matter. Most of the ordinances provide for the erection of poles under the supervision of the city, town, or village authorities in charge of streets and of public safety. Nine communities specified a certain kind and character of pole, etc., to be used, and defined the manner of placing the poles and wires, the height of wires and lamps from the ground, the distance of the poles from the curb, etc. These safety provisions, it may also be noted, are subject to the National Electrical Code. Six of the franchises fixed the maximum rate of charge, and two reserved the right to buy the plants operating under the franchises.

The work of the board of gas and electric light commissioners in Massachusetts.—Reference has been made to the conditions existing in the state of Massachusetts, and to the effective work there of the board of gas and electric light commissioners, which has been in existence for some 20 years. This board, while acting as a barrier between private operation and undue competition, has in no wise unduly restricted the action of any community that has desired to establish a plant of its own. It would, indeed, seem to have fostered municipal ownership. Under the legislation enacted and vigilantly enforced by this board, a municipality can undertake the business of electric lighting only upon the passage of certain specific resolutions by the bodies of the electors, etc. After any action upon the proposition, whatever the result of voting, the city or town clerk must forthwith transmit to the board a certified copy of so much of the records of the city or town as relate to the result of the vote. So also, if after authorizing the operation of the plant, it is subsequently voted "to establish, purchase, reconstruct, extend, or enlarge a plant or to issue bonds on account of same, or to regulate the measure or conduct thereof, or to adopt an ordinance or by-law relative to such plant," the city or town clerk must, within ten days after such vote, transmit a certified copy thereof to the board. It is obvious that such requirements insure close supervision.

Municipalities are forbidden to change the price of gas or electricity oftener than once in three months, and when any price is fixed or change is made the management is bound to send a certified copy of the notice of such change to this board. The law requires that "the price shall not, except with the written consent of the board of gas and electric light commissioners, be fixed at less than cost, in which shall be included all operating expenses, interest upon the net investment in the plant, less assessments collected from abutters for extension of pipes or lines at the rate paid upon the bonds, the requirements of the sinking fund established to meet such bonds, and also the depreciation of the plant to be reckoned at not less than 5 per cent per annum of its cost and losses, but any losses exceeding 3 per cent of the investment in the plant may be charged in different years at not more than 3 per cent per annum. Such price shall not be greater than shall allow above such cost a profit of 8 per cent per annum to the city or town upon its net investment. The gas and electricity used by the town shall be charged to it at cost." While the depreciation thus fixed is regarded as low, it is obvious that it acts as a preventive against operating such plants at a serious loss.

An interesting instance of the power of the board in such matters is found in its action in 1902 in the case of Newton, Mass., where it interposed between the municipality and a private company. A certain price for street lighting was insisted upon by the municipality, but it was shown that the rate was too low, and that by insisting upon it the municipality would discriminate against the private customers, who would have to be charged unduly to offset the low rate at which the municipality desired to obtain its street lights. The

board is authorized also to require a city or town to supply a person or corporation aggrieved by its refusal to furnish gas or electricity.

There are various requirements as to careful book-keeping. "A city or town which manufactures or sells gas or electricity for lighting shall keep record of its work and doings at its manufacturing station, and in respect to its distributing plant as may be required by the board. Books, accounts, and returns shall be made and kept in form prescribed by said board and the accounts shall be closed on the 30th day of June annually, and a balance sheet of that date shall be taken therefrom and included in the return to said board. The mayor and selectmen or municipal light board, if any, shall annually on or before the second Wednesday of September make a return to said board for the year ending on the 30th of June, signed and sworn to by the mayor or a majority of the selectmen or municipal light board, if any, and by the manager, stating the financial condition of said business, the amount of indebtedness, both authorized and existing on account thereof, a statement of income and expenses in such detail as the board may require, and a list of its salaried officers and the salary paid to each. The mayor, selectmen or municipal light board, and manager shall, at any time on request, submit the books and accounts to the inspection of said board and furnish any statement or information required by it relative to the condition, management, and operation of said business."

There is also a provision, which is apparently of very wide scope, as follows: "All general laws relative to the manufacture, use, or distribution of gas or electricity or to the quality thereof, or to the plant or appliances therefor, shall apply to such city or town in the same manner as to persons, so far as applicable and consistent with the provisions of this chapter." The meaning of this passage has never been tested, but would appear to give the board every authority over the affairs of electric lighting business conducted by a municipality just as it is exercised by the board over companies, except where from the nature of the business of a municipal corporation it would be impossible to apply such authority. This authority as exercised in the case of incorporated companies operating under franchise conditions is close and rigid, a full report, as outlined above, being required with regard to all the affairs of the companies and very strict regulations being enforced with regard to the bonded obligations and capital stock of the companies. No new issuance of securities is allowed without a thorough investigation, so as to limit the amount to the value of the new property created and to the necessities of the business. In like manner the board serves as a protector of existing private companies, and does not allow the introduction of new competition unless it is absolutely proven that the company in the field is not living up to its opportunities and that competition would therefore be of benefit to the public.

There is discussion among the private companies in Massachusetts, and a difference of opinion, as to whether the board has served to protect them effectively from competitive "raiding," but the general opinion in the state seems to be that the services of the board have been considerable and of high value, and that without the board the electric lighting and gas industries of Massachusetts would not be upon their present footing of efficiency nor would they be able to give the service to the public that they render. The legislation in Massachusetts relative to the work and power of this board dates back to 1891, and has been amended from time to time; moreover, it has been a model for other states. In discussing the action and results of the law, Prof. E. W. Bemis says: "The extreme restrictions in Massachusetts are due to the intense efforts of the lighting companies. It took a three years' struggle to get the law, and even then it was not possible to pass it except with amendments which seriously diminished its value. The law, however, is much better than none. Before it was passed cities and towns in Massachusetts had no power to establish electric plants even to light their own streets." An interesting and significant result of the creation of this commission is the fact that Massachusetts appears to be the only state in the Union in which full and authentic accounts are kept of the central station industry. This fact alone is a pertinent argument for the value and utility of the board.

CHAPTER VIII.

HISTORY AND DEVELOPMENT OF ELECTRIC LIGHTING.

General discussion.—Luminous effects, associated with the production of electric phenomena, were noted by many experimenters and physicists prior to 1800, but the history of electric lighting dates back only to the beginning of the last century; while the history of central stations proper belongs to the second half of the century, and, in reality, so far as its relation to the public is concerned, may be considered as belonging only to the period dating from 1875. In other words, although a great deal of work done in the preceding seventy-five years was of an eminently practical nature, embodying the inventions of a long series of illustrious discoverers and experimenters, many of whom have lived to see this great art in its present manifestations, the commercial and industrial development is limited to a quarter of a century.

The thousands of central stations and isolated plants, with their millions of lamps and motors scattered throughout the world, are based fundamentally on the application of a few elementary principles of electricity, and even the newer appliances which have marked the opening of the present century are the reduction to practical form of theories and principles determined at a very early stage, needing but the energy of the inventor or the skill of the engineer to render them useful and available.

I.

THE ARC LIGHT.

Batteries as sources of current.—Electric lighting may be said to have begun with the work of Sir Humphry Davy while an assistant lecturer in the Royal Institution in London. He demonstrated Volta's theory of obtaining electricity from cells consisting of unlike metals immersed in a liquid, and was one of the first to apply this new source of power to the investigation of the elements. In 1808, with the aid of a few wealthy members of the institution, Davy constructed a battery comprising no fewer than 2,000 cells (up to that time the institution had had but 500 cells) grouped in 200 porcelain troughs. The liquid employed in each cell was a mixture of 60 parts of water with 1 of nitric and sulphuric acid, the plates were zinc and copper squares, affording 32 inches of surface. While the effect produced by any one of these cells (which were quite analogous to those still in general use) would be very feeble and insignificant, their combined action was quite notable, especially when applied to the consumption of sticks of wood charcoal. Davy exhibited his battery before the members of the Royal Institution in 1809–10 with brilliant and impressive results, which he described as follows: "When pieces of charcoal about an inch long and one-sixth of an inch in diameter were brought near each other (within the thirtieth or fortieth of an inch), a bright spark was produced, and more than half the volume of the charcoal became ignited to whiteness; and by withdrawing the points from each other a constant discharge took place through the heated air in a space equal to at least 4 inches, producing a most brilliant ascending arc of light, broad and conical in form in the middle." These sticks of wood charcoal, exposed to the air and to such a current, wasted away very rapidly by combustion in the arc; and as the apparatus was not provided with a regulator, such a demonstration was necessarily of a very fugitive character. For over thirty years the production of electric light in the arc thus described remained a brilliant and expensive laboratory experiment, and, indeed, but for the invention of the modern dynamo electric machine, would have so continued, although a great deal of interesting work was done in the improvement of the carbons by experimenters who still employed primary batteries as the source of current.

Earliest exhibition and use of arc lights.—In 1844 the French physicist, Foucault, after whom well-known electric phenomena have been named, hit upon the idea of replacing the soft wood carbon by that deposited in gas retorts; this he cut into square sticks. This carbon, while a decided improvement, contained silica and alkaline earths, which in fusing and vaporizing broke up the carbon and disturbed the arc. Foucault was able, however, by using the Bunsen battery in conjunction with such carbons, to produce a remarkably steady and continuous light. He was able to use the light even for photographic purposes by employing these graphitic carbons and powerful batteries. A great step forward was thus made.

It deserves mention here, however, in connection with the use of electric light for photographic purposes that some work had already been done in America. In the Journal of the Franklin Institute for 1843 record is made of the fact that in November, 1840, with the large

ISLE OF SAFETY ON LOWER FIFTH AVENUE, NEW YORK CITY.

This artistic fixture combines arc and incandescent lighting and serves also as a halting place for pedestrians.

battery of 500 cells belonging to the laboratory of Yale College, Prof. B. A. Stillman, jr., and Dr. W. H. Goode secured photographic impressions by light reflected from the surface of a medallion to the iodized surface of a daguerreotype plate. Two pictures were thus obtained, one of the medallion only and the other just showing a blur or halation due to the light from the charcoal points, just as to-day one sometimes sees the halation in poorly executed photographs.

The Foucault arc light was exhibited publicly in Paris by Deleuil, and its availability and adoption for lighting houses, squares, and streets began to be generally discussed. The new illuminant was not able, however, to compete on anything like equal terms with such rivals as gas, oil, and tallow. The inconvenience attaching to the use of the batteries, as well as that attendant upon controlling the lamps by hand, discouraged anything but the most limited use. As a matter of fact, however, the first practical work belongs to this period, when "an electric sun" shed its beams upon the stage during the presentation of Rossini's opera "Moses" at the Paris Opera House. This interior employment was matched by Deleuil on the Place de la Concorde, where the lamp was placed on the knees of the statue of a woman typifying the town of Lille. This out-of-door illumination excited a great deal of attention and comment. It is hardly necessary to add that the presence of a man to regulate the lamp by hand was not particularly impressive as to its features of economy and availability. After the exhibition in the Place de la Concorde other electric lamps were set up in Paris on the Pont-Neuf over the Seine, on the Arc de Triomphe at the crest of the Champs Elysées, in the large court of the Palais Royal, and at the Porte Saint-Martin. All such work, however, was evanescent, though well directed and backed by persons of influence.

The first public exhibition of arc lighting in England was made by Mr. E. E. Staite at Sunderland, and during the next four years he gave demonstrations in other English towns. His work made such an impression that in 1852 the dock commissioners of Liverpool built a high tower for the purpose of placing an electric arc upon it for light house purposes; but Mr. Staite died in that year and the project seems to have gone out of existence with him.

Automatic adjustment of carbons.—In 1845 Thomas Wright, of London, made another long step forward by devising a lamp in which the carbons were automatically adjusted. In this lamp the carbons were made in the form of disks rotating by clockwork, with a slow, continuous motion, the arc forming at that point on the two peripheries where they most closely approached each other, so that the arc may be roughly described as having nibbled away the edges of the two carbon wheels as they revolved. To obtain an arc between the two plates or pencils of carbon it was necessary to start a current in the circuit, either by bringing the carbons into contact with each other or by some other device, and when the current had been thus established the edges of the carbons had to be fed together and kept within a certain slight distance of each other so as to maintain the proper length of the arc. The operation of "striking the arc" and regulating the feed of the carbons toward each other was done by hand before Wright's invention, which was followed by those of Staite in 1847, Foucault in 1849, Serrin in 1857, and Duboscq in 1858. The last named made what is spoken of as the first real arc lamp, one for laboratories.

In 1855 La Cassagne and Thiers, of France, brought out their regulator patents, which employed a column of mercury and special mechanism—two separate electromagnets—to lift and feed the carbons. With this apparatus they lighted the Quai des Celestins, at Lyon, in June of that year, eliciting very enthusiastic descriptions from the journals of the day.

Improvements in carbons.—About the same time these two inventors improved also the carbon used in arc lamps by dipping pieces of gas carbon in a solution of caustic potash or soda, and then exposing them to a very high temperature to transform the silica of the carbon into soluble silicate. By washing the carbon sticks in hot water, and then subjecting them to chlorine at red heat, the components that had not been acted upon by the potash were transformed into volatile chlorides of silicon, potassium, iron, etc. The light obtained from these carbons was steadier, but a great deal of ashes and dust resulted.

In 1846 Greener and Staite also patented processes for improving the manufacture of carbons, and in this as well as in other ways the quality of the light was improved, subject, however, to the fatal limitation of the batteries as sources of current. As the best of the batteries could give a pressure of only 1 or 2 volts, while that needed to maintain an arc of one-tenth inch is 60 volts. With the amount of pressure needed increasing rapidly as the arc or space between the carbon points is lengthened, it is readily seen that a large number of batteries would be required to maintain even a single arc lamp in operation; hence an attempt to operate a circuit from batteries, whether the lamps were strung in series or in parallel, would make the problem quite unmanageable. Some of these features, in connection with the lamp itself, will be dealt with more fully in the discussion of that part of the system.

Dynamos as sources of current.—It has been the custom of popular writers to date the beginning of the modern period of arc lighting, dependent upon dynamos as sources of current, from the work of Z. T. Gramme, a Belgian inventor, residing in Paris. His first patent was taken out in 1870 and his first dynamo electric machine was submitted to the Academy of Sciences in 1871. While this view is fair and broadly justified, and while the modern central station was founded upon

such apparatus, it must not be forgotten that commercial arc lighting had already been accomplished with other types of electric machines; that a vast amount of successful work had already been performed in the production of such apparatus, and that all this machinery was based primarily upon the law or principle discovered by Faraday, according to which, if magnets or coils of wire be constantly moved or displaced in relation to each other, electric currents are set up in the wires or conductors, the quality of the current depending upon the strength and number of magnets, the velocity and direction of their movements, and the number of coils or the turns of wire in each one of them. Such a mechanism of magnets and coils can be operated by hand or by animal power. The magnets can be thrust rapidly into the coils of wire and be drawn from them by reciprocal motion. Some of the earliest electric motors were devised to operate upon this method, but the reciprocating plan has never found successful application in electric generators, although within recent years Mr. Tesla has revived the idea by some very ingenious work in that field with his "oscillators." Ordinary revolution of the coils in juxtaposition to the magnets, or vice versa, is more simply effected than the reciprocating movement, and can be best applied by means of a steam engine or a water turbine, insuring a smooth rotary motion, which can be maintained for several hours, even with extremely heavy revolving parts. In some of the first apparatus of this character bar or permanent horseshoe magnets were employed in what are still known as magneto-electric machines, but these were soon replaced by electro-magnets, in which coils of wire were not only revolved in front of the magnets, but other coils were placed on the limbs of the magnets, so that the slight current at first produced in setting the apparatus in motion could be increased and intensified by the reaction between the magnets and the revolving armature coils.

The following is a quotation on this subject from the significant discourse of Professor Tyndall on the discoveries of Siemens and Wheatstone in this direction:

> On the 4th of February, 1867, a paper was received from the Royal Society, from Mr. William Siemens, bearing the title, "On the Conversion of Dynamic into Electrical Force without the use of Permanent Magnetism." On the 14th of February a paper from Sir Charles Wheatstone was received bearing the title, "On the Augmentation of the Power of a Magnet by the Reaction thereon of Currents Induced by the Magnet Itself." Both papers, which dealt with the same discovery, and which were illustrated by experiments, were read upon the same night, viz, the 14th of February. The whole field of science hardly furnishes a more beautiful example of the interaction of natural forces than that set forth in these two papers. You can hardly find a bit of iron, you can hardly pick up an old horseshoe, for example, that does not possess a trace of permanent magnetism; and from such small beginnings Siemens and Wheatstone have taught us to rise by a series of interactions between magnet and armature to a magnetic intensity previously unapproached. Conceive the Siemens armature placed between the poles of a suitable electro-magnet. Suppose the latter to possess at starting the faintest trace of magnetism; when the armature rotates, currents of infinitesimal strength are generated in its coil. Let the ends of that coil be connected with the wire surrounding the electro-magnet. The infinitesimal current generated in the armature will then circulate around the magnet, augmenting its intensity by an infinitesimal amount. The strengthened magnet instantly reacts upon the coil which feeds it, producing a current of greater strength. This current again passes round the magnet, which immediately brings its enhanced power to bear upon the coil. By this play of mutual give and take between magnet and armature the strength of the former is raised in a very brief interval from almost nothing to complete magnetic saturation. Such a magnet and armature are able to produce currents of extraordinary power; and if an electric lamp be introduced into the common circuit of magnet and armature we can readily obtain a most powerful light. By this discovery, then, we are enabled to avoid the trouble and expense involved in the employment of permanent magnets; we are also enabled to drop the exciting magneto-electric machine and the duplication of electric magnets. By it, in short, the electric generator is so far simplified and reduced in cost as to enable electricity to enter the lists as the rival of our present means of illumination.

A great tribute is paid here to Siemens and Wheatstone, but some of the merit of this remarkable discovery of the principle of mutual accumulation must be claimed also for the late Prof. Moses G. Farmer, a distinguished American, who, as early as 1865, built small dynamo electric machines in which, to use his own language, "I had the satisfaction of seeing the problem of mutual reaction and accumulation fairly solved." In confirmation of this, may be quoted the following passage from the Manchester, England, Literary and Philosophical Society's Proceedings, Volume VI, page 107:

> Mr. Wilde has also received a letter on the subject of his recent experiments in magnets from Moses G. Farmer, of Salem, Mass., U. S. A., dated November 9, 1866, in which he says that he had obtained an increase of 31 per cent in the power of a magneto-electric machine, by transmitting the current from the armature through the coils of wire surrounding pieces of soft iron, forming prolonged extremities of the permanent magnets of the machine.

It will thus be seen that before the day of Gramme others had done work in connection with the evolution of dynamo electric machinery of the modern type, and, moreover, arc lighting had actually been accomplished on a large scale with the older type of apparatus. For example, under the superintendence of Faraday, the light house department of England, employing the Alliance apparatus devised by Nollet and Van Malderen, of Belgium, introduced the electric light in its important beacons at South Foreland and Dungeness, commanding the Straits of Dover. The preliminary trials were made in 1857, and the protecting beams of the intense electric arc were first thrown over the sea from South Foreland on December 8, 1858, and from the cliffs of Dungeness on June 6, 1862. The Alliance dynamo thus employed was built originally for the strange purpose of decomposing water, in order to employ the resulting gases in the production of light, but a much more direct and pertinent application was now made of it. The outer framework supported 24 com-

pound steel permanent magnets in banks of 3 each, and within the circular area they thus inclosed revolved the armature, which consisted of a drum carrying 32 spools of copper wire wound on iron cores. As these coils of wire thus revolved in front of the magnetic poles pointing inward, currents of an alternating character were developed in the coils, and were taken off by metallic collectors at the end of the armature shaft and were carried by wires to the large arc lamps devised by Professor Nollet. Similar work was done in 1863 at La Heve, near Havre, France, and the light was also employed at the Cherbourg docks. It is obvious that such machinery and methods were too uncertain and expensive to become generally available to the public, although they were in a sense commercial.

Alternating and direct currents.—The alternating current had to wait a score of years before its usefulness for general distributing purposes in connection with central stations could be demonstrated, all the initial lighting work from central stations being done by means of direct or continuous currents which were employed alike for arc and incandescent lighting. The alternating current may be imagined as flowing or surging to and fro in the circuit, so that if the circuit be compared with a water pipe the current would be discharged into the pipe at one end with one impulse and into the other end with the succeeding impulse from the feeding source. On the other hand, the direct or continuous current may be pictured as flowing steadily in one direction around the circuit so that the polarity is never changed or reversed.

Electric motors.—The supply of current to stationary motors for power purposes has been shown by many portions of the preceding text to constitute an important element in the central station industry of to-day. It is hardly necessary, however, to enter here into a discussion or historical review of the motor development, as it has already been done at some length in the bulletin on Electrical Apparatus and Supplies, issued on August 25, 1902.[1] It was pointed out that the discovery of the reversibility of the dynamo released electric power from the trammeling conditions that had hindered its development, and that following the first electrical exhibition in Philadelphia in 1884, the work of such men as Brush, Thomson, Daft, Sprague, Curtis, and Crocker, Wheeler and many others, soon resulted in the development of highly efficient motors, capable of application to the widest range of industrial requirements. The early motor work, as in the case of electric lighting, was done with direct current motors, and the next step forward was taken in the development of single phase alternating current motors. Then the inventions of Mr. Nikola Tesla and of other prominent inventors created the successful polyphase motor, and for some years past, as a result of such work, the entire art of electric generation and utilization of current has been dominated by polyphase conditions in a manner that has already been indicated in this text.

The Gramme armature.—The chief merit in the work of Gramme, whose improved dynamo gave such a stimulus to electric lighting, consisted in the construction of an armature employing essentially the soft iron ring wrapped around with consecutive lengths of insulated wire, which thus formed a number of short distinct coils. Up to that time all armatures had been constructed like unbroken spools of cotton on a reel or like balls of yarn wound on blocks. The ends of the Gramme coils were brought out and formed into one circuit. In other words, the bobbins or coils were placed close together on the iron core, and the inner end of each bobbin was soldered to the outer end of the neighboring one, so that the entire number of bobbins formed a series of convolutions constituting an endless electric circuit. Each coil or bobbin might have any number of convolutions of insulated wire, and the number of bobbins might also be varied, the changes in both respects depending upon the object for which the machine was intended. The ends of these coils were then brought out to the commutator delivering current to the collector brushes that rested on it, which in turn connected with the wires of the outer circuit upon which were grouped the lamps or motors.

Jablochkoff's lamp.—Shortly after the introduction of the Gramme machine a new era in electric lighting began on both sides of the Atlantic. A further advance in arc lighting was made by Jablochkoff, who in 1876 patented his arc lamps all over the world. This type of lamp was marked by an absence of much of the mechanism that had previously encumbered electric illuminating appliances. It consisted, broadly, of two vertical, parallel sticks of carbon separated slightly by an insulating material, such as kaolin, which was consumed at the same time as the carbons. These lamps were found to burn best with alternating current, which insured an even consumption of the carbons. They were soon to be seen burning on the streets of European cities, and found popularity in the United States as well, one of the first places in this country in which they were employed being the Wanamaker stores in Philadelphia.

American achievements.—American inventors were loath to leave this field to foreign competitors, and the closing years of the third quarter of the last century saw an enormous outburst of activity on their part also, with a corresponding movement in finance and industry. Among the leading workers of this period were Messrs. Charles F. Brush and Edward Weston, the former working at Cleveland, Ohio, and the latter at Newark, N. J. Both of these men worked along the line of the development of methods of series arc lighting, and their systems were soon largely and widely introduced here and in Europe.

[1] Twelfth Census, Vol. X, page 153.

The first Brush series arc lights were erected in the public squares of Cleveland, Ohio, in 1879, and shortly thereafter local Brush electric lighting companies were started in all the large cities and towns of the country, millions of dollars being raised for the purpose, and leading public men associating themselves readily with the enterprises. The first central station operating arc lamps was installed by the California Electric Light Company of San Francisco in 1879; the Brush system was employed. Neither Europe nor Asia escaped this American influence, for the Brush system was introduced in England at a very early date, and companies were organized in Japan and China also.

The Brush arc lamps were not only erected on short poles like ordinary gas lamp posts, but were also raised to the summit of lofty masts and metal towers so as to give the effect of a subdued moonlight, and for a time it was a question whether the tower or the lamp post would survive for urban electric illumination.

A very interesting and important chapter in the arc lighting history of this period was that contributed by William Wallace, of Ansonia, Conn., and Prof. Moses G. Farmer, of Salem, Mass., the former a pioneer copper and brass manufacturer, and the latter a prolific and original inventor of electric appliances. At an early date Mr. Wallace began to build dynamos intended for the work of electric deposition. It was inevitable that this work should lead to experiments in the field of electric illumination, and as a result the Wallace-Farmer dynamo was constructed and exhibited at the Philadelphia Centennial Exposition of 1876, where it was the only dynamo that supplied current for use in any way for the illumination of the Exposition buildings and grounds. The same inventors also exhibited at Philadelphia another machine, which had a capacity of energizing 11 arc lamps; an interesting feature in connection with this machine was the use of laminated iron plates in the armature, instead of solid cast iron cores, with corresponding increase of efficiency, lessening of heat in the machine, etc. A number of arc lamps also were built by Mr. Wallace, the first dating back to 1875; in this lamp and also in later ones flat or plate carbons were used. The arc traveled along the edges of the plates and thus maintained itself for a considerable period.

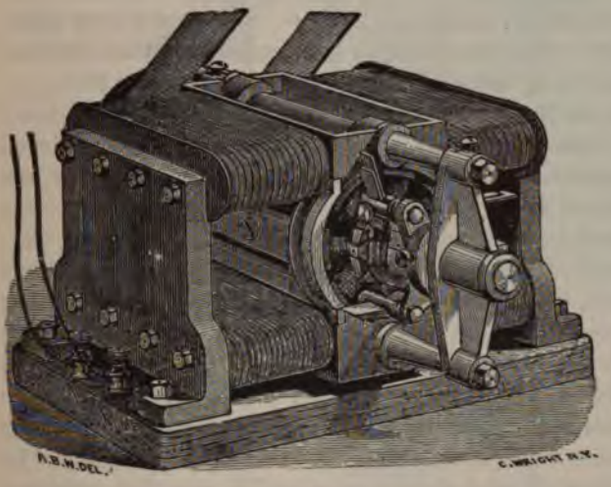
Mr. Wallace was one of the first to construct machines from which arc lamps were run in series, and at an early date began the manufacture of carbons, it being claimed in his behalf that he was the pioneer in the production of the round carbon pencil or point now so universally used. His works and appliances in carbon manufacture thus antedated those of Carré and others in Europe.

The work done by Mr. Wallace was on the whole of an intensely interesting character and of great originality. In some of his lamps as many as 12 carbons were employed, and in one lamp no fewer than 48 carbon pencils were operated—24 above and 24 below—the arc traveling from pencil to pencil as they burned away and the feeding being accomplished by a small electromagnet at the side of the lamp frame. The Wallace work, however, was based generally upon the use of low potentials, in contradistinction to the high potential with which commercial arc lighting is associated.

The Wallace and Farmer inventions soon became merged in the body of the industry and lost individuality, but not before imparting a tremendous impetus, the effects of which were directly felt by such men as Edison and Sprague, and are to-day freely acknowledged.

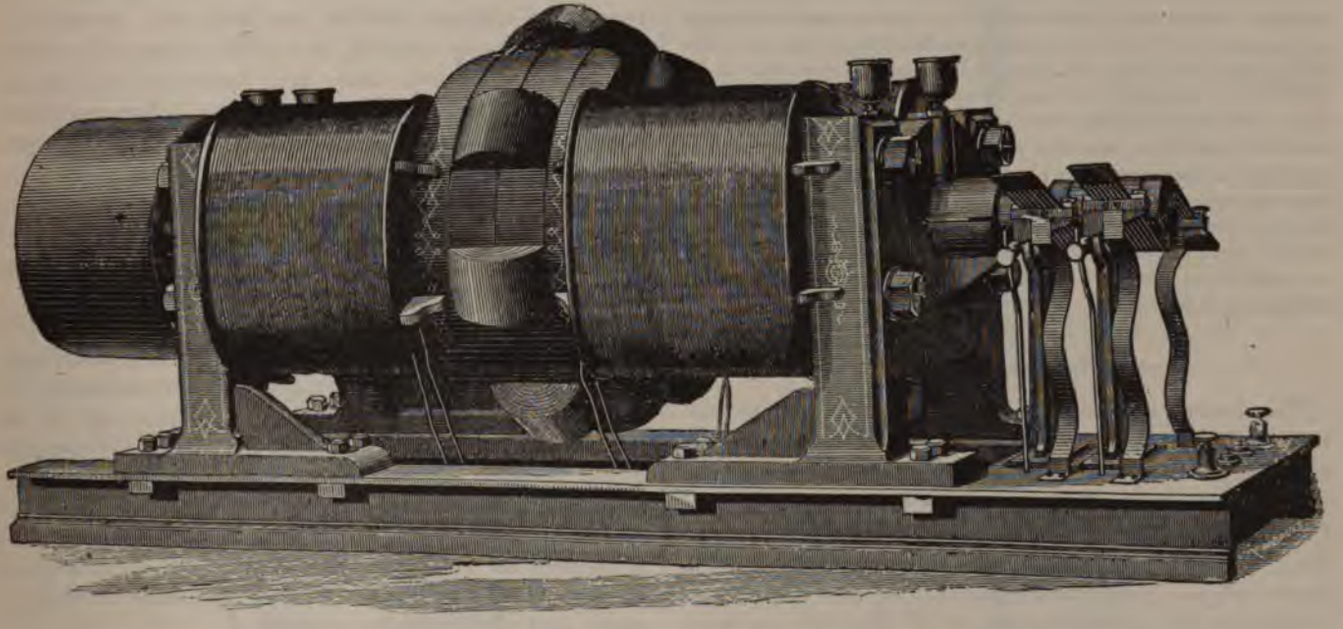
Indoor use of the arc lamp.—Early efforts were also made to introduce the arc lamp indoors, and Boston, Mass., witnessed one of the first attempts in this direction. Mr. Brush exhibited a small arc lighting dynamo at the Mechanics' Fair in Boston in October, 1878, and the following month this plant was put into regular service in a clothing store on Howard and Washington streets, its use being intended as much for advertising as for illuminating purposes. The lamps instead of using the cylindrical copper-coated carbons with which we are familiar had uncoated square carbon rods costing 25 cents each. The dynamos to which these lamps were connected had four cast-iron magnet arms with four flat pole pieces, between the faces of which revolved a cast-iron armature, upon which were wound four separate circuits of insulated wire, connected to as many pairs of independent commutator segments, upon which rested the brushes that collected the current from them. The eight coils of wire on the armature were wound in slots and were grouped into four separate pairs, to form four circuits. Each of these circuits to the commutator and from it was connected with a single arc lamp, so that the machine was what is known as a "four-arc lighter," and each lamp had a circuit of its own. There being no automatic cut-outs for the lamps in those days, the circuit was completed only through the shunt coils of the lamp magnets when the carbons burned out. The wiring was equally primitive, and when the four circuits were installed in the clothing store they consisted of bare No. 6 copper wire, secured in place by iron staples spiked over them into the woodwork.

Earliest improvements.—Among the earliest improvements were those looking to the increase of capacity in arc lighting dynamos; the regulation of the lamp; the introduction of devices which should allow a circuit to remain in operation even if one or more lamps became disabled; the placing of two sets of carbons in one lamp so that when one became consumed the other could be cut in, continuing the lamp in operation; and the electric copper plating of carbons, which lessened the resistance of the circuit within the lamp itself.



FULLER TYPE OF GRAMME DYNAMO BUILT IN U. S. A., 1878.

EARLY TYPE OF STANLEY ALTERNATOR.



EARLY TYPE OF BRUSH OPEN-CIRCUIT ARC-LIGHTING DYNAMO.
Fac-simile reproduction of an early engraving.

Street lighting.—The arc lighting companies began to take contracts for city street lighting, and $1 per night per arc lamp was by no means an unusual price, the amount of light furnished being what is known as "2,000 candlepower." This invasion of the field of street lighting led to another increase in the capacity of the machines, and in the length of the circuits to which they furnished current.

Weston's arc lamps and dynamos began to be used in considerable numbers during this period, and several of his 10-light machines would be coupled into a single series circuit of 40 or 50 lamps. The arcs were of the short hissing character requiring a pressure of from 20 to 30 volts per lamp and a volume of 18 or 20 amperes of current on the circuit. The dynamos and lamps of J. J. Wood and W. Hochhausen also became widely known and used.

About 1881 the Thomson-Houston system made its appearance and the first 25-light arc machines of that type were built at New Britain, Conn., circuits of 10 amperes and 40 or 50 volts to the arc being employed. The best summary of the conditions encountered in 1883 and 1884 is that furnished by Prof. Elihu Thomson, when he said:

> The arc lighting systems were not without their difficulties. Good carbons were not always to be had, and crooked ones were common. Opal globes were very thick and absorbent, while for indoor uses the 10-ampere arc with clear ground globe was too intense. Construction of the line and apparatus was not easy, owing to the lack of suitable materials and labor. Copper wire without soldered joints could be obtained only in lengths aggregating a few pounds. Armature iron for dynamos was of uncertain and irregular quality. Of insulating material there was very little variety and often it was not high grade. Baking ovens came later. We had to construct our own measuring instruments and standards, as suitable ones were not to be bought. The plant after construction and installation was often at the mercy of poor power and of unskilled attendants. The plant had to take care of itself in a large measure. It is interesting to note that the man in charge of the Lynn arc lighting station in 1883, who ran the engine and several arc lighting dynamos, would lock up the station for an hour or so at a time, while he was out patrolling the line; everything continuing in full blast.

II.

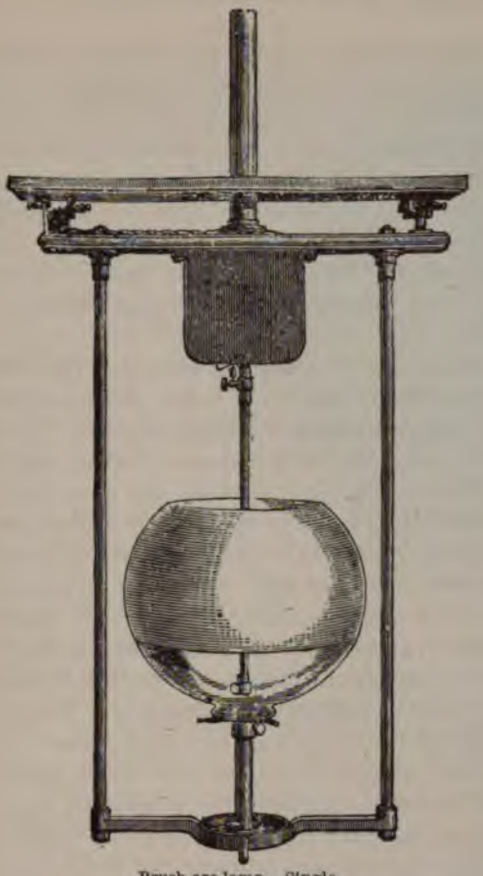
THE INCANDESCENT LIGHT.

The furore and success attending arc lighting had had its influence upon the perfecting of the incandescent lamp, and several distinguished inventors on both sides of the Atlantic—notably Swan, Lane-Fox, and Crookes in England, and Edison, Brush, Sawyer and Man, Weston and Maxim in this country—devoted their energies partly or exclusively to this field. The production of a perfect commercial incandescent lamp soon virtually resolved itself into a race with a prize of inestimable value as its goal. The result aimed at was a lamp that would permit the minute subdividing of the electric current, so that lights corresponding to gas jets in their size, general utility, and economy could be furnished. Arc lamps run at high pressure with currents of dangerous voltage were applicable only to large spaces, and with aerial circuits, more particularly to street illumination—a comparatively restricted field. They left untouched almost the entire domain of interior illumination—the largest market and principal area for artificial illumination.

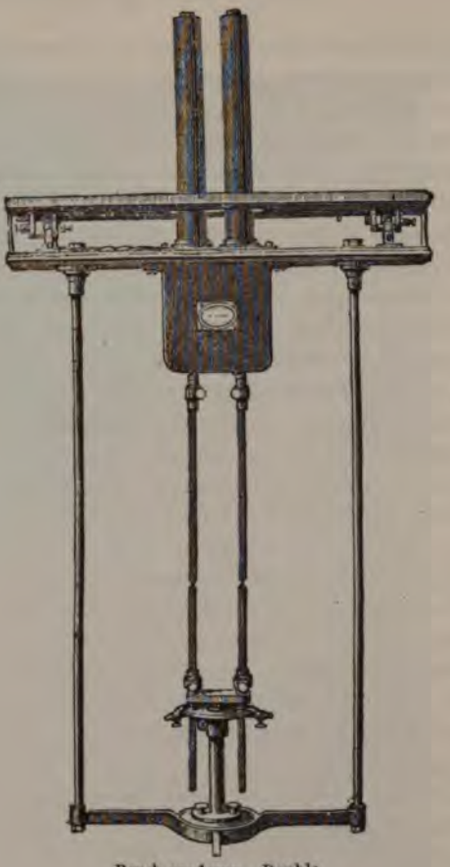
The first lamps.—The fundamental principle of obtaining illumination by rendering a body incandescent with electric current was by no means new, but dated back to the first half of the century. The essential ideas were described as early as 1841 by De Moleyns, who in that year patented in England an electric lamp of crude form in which a platinum wire to be rendered incandescent by the passage of an electric current was inclosed in an exhausted glass bulb. A few years later a most interesting lamp was devised by Starr, of Cincinnati, Ohio. He died in 1847 at the early age of 25 years, but before his death he had done a great deal to perfect his lamp and a magneto-electric dynamo with which to furnish current to it. This young man, as early as 1844, called attention to his apparatus in the Cincinnati "Advertiser," and proposed to install on high towers some lamps that would "enable a light to be diffused all over Cincinnati equal for practical purposes to that of daylight." The Starr lamp consisted of an exhausted glass globe in which was a thin strip of graphite held between two clamps affixed to a porcelain rod, the latter being suspended by a platinum wire sealed in the globe. This lamp is said to have given an excellent light and, as will be noted, involved the essential elements of incandescent lamps of the present day, namely, a carbon member inserted, and brought to incandescence by current, in a globe exhausted of air. This early American lamp was patented by King in England in 1845, and was described as being extremely promising for its purity, brilliance, and strength. Dredge's "Electric Illumination," a standard work, asserts that King manipulated affairs so as to keep Starr in the background and deprive him of reward and credit for inventions that anticipated much valuable work of later date.

Edison's experiments.—None of this early work left any permanent results, and the commercial subdivision of electric lighting was set down as impracticable by some of the foremost scientific authorities up to the very moment (twenty-five years ago) when Edison produced his first lamps and used them for general illuminating purposes. Without detraction to the other notable and meritorious work done in this field, his achievements may be cited as typical and illustrative of the underlying principles, of the difficulties to be overcome, and of the results attained.

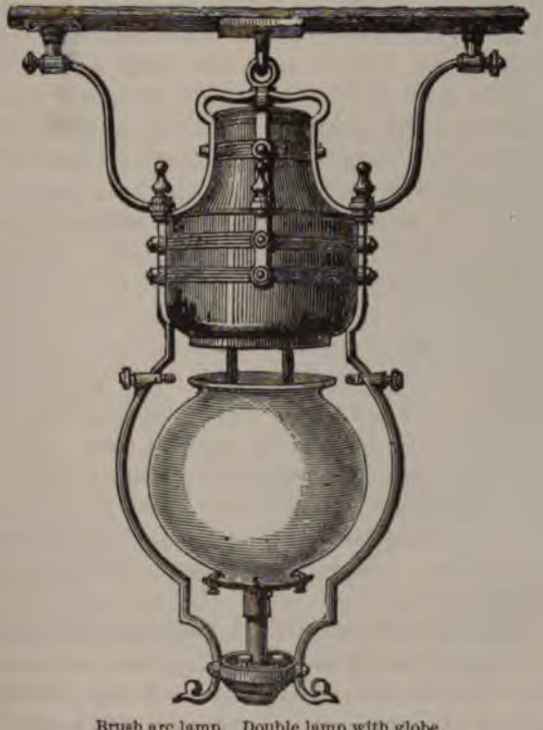
His experiments on carbon as a material for use in electric work began in 1876, and in the fall of 1877 strips of carbonized paper were tried as an incandescent conductor suitable for use in small lamps. Work along this line was continued until January, 1878, and resumed again in the fall of that year, when Mr. Batchelor, one of Mr. Edison's leading associates, made for illuminat-



Brush arc lamp. Single.



Brush arc lamp. Double.



Brush arc lamp. Double lamp with globe.

Thomson-Houston arc lamp.

EARLY TYPES OF ARC LAMPS.

ing purposes a great number of carbons from tissue and other kinds of paper, coating their surface with a mixture of lampblack and tar, rolling them up into the fine long form of a knitting needle, and then carbonizing the "filament" thus obtained. These filaments were put into circuit, in a vacuum in a glass globe, and brought to incandescence so that they gave light; but they would only last an hour or two. Other carbons made from wood and broom corn were tried. To quote Mr. Edison, "What we desired at that time and had settled our minds upon as the only possible solution of the subdivision of electric lighting was that the lamps must have a high resistance and a small radiating surface." The carbons made at that time showed that the lamps must have at least 100 ohms resistance to compete successfully with gas. This means that with filaments of such a resistance the current flowing in the circuit would bring them to light giving incandescence. If the lamps were of lower resistance, requiring more current, and therefore more copper in the circuits delivering the current to the lamps, the cost of the copper main conductors would be so great and the cost of power so increased as to render the system expensive and commercially impracticable.

At this time Mr. Edison went back to some of the earlier experiments involving the use of platinum strips, and by means of the Sprengel mercury pump he obtained an almost perfect vacuum; but it was soon found that metal filaments were not feasible, at least not under the conditions prevailing at that day. In October, 1879, separate lamps independent of the air pump were made by Mr. Edison, the receiver or bulb being entirely of glass, with filaments of common sewing thread carbon attached to leading-in wires, sealed in by fusion of the glass, the whole contrivance being exhausted by the Sprengel pump to nearly one-millionth of an atmosphere. The filaments of carbon thus employed were quite fragile, but because of their minute mass and length of only a few inches they had a smaller radiating surface and a higher resistance than had been expected, and the point had virtually been reached at which the carbons were in a stable condition. In other words, the filaments under the action or attrition of the current would not break down within an hour or two, but would remain incandescent for some time. Some of these paper filament lamps yielding from 12 to 16 candlepower had a remarkably long life, the average being 300 hours, while one of them lasted 940 and another 1,350 hours.

Mr. Edison was not satisfied, however, with filaments made from carbonized paper, nor with those made from the more regular and homogeneous wood fiber. One day a palm leaf fan was lying upon one of the tables of the Menlo Park laboratory, and the bamboo rim on the outside attracted Mr. Edison's attention. This bamboo he cut into strips which he carbonized and put into the lamps. He was gratified to find that the filaments were several times better than anything he had succeeded in making before. Mr. Edison proceeded immediately to study the whole subject of bamboo, and sent a man to Japan to investigate the bamboo growths of that country. Before he had selected what was most suitable for his purpose he had tested no fewer than 6,000 vegetable fibers. Until 1894 all the Edison filaments were made from bamboo, each piece passing through eight separate hand operations.

Summary of subsequent history.—The subsequent history of the incandescent lamp, embracing the inventions and improvements of a large number of workers in this field, may be briefly summarized at this point. Mr. Edison at this time reached the conclusion that a successful lamp must be inclosed by a globe made entirely of glass, with all the joints fused, and with the air exhausted to a very high degree, and that the lamp must be made durable and yet so cheap that it could be thrown away when broken down, with the exception of the platinum used for the leading-in wires, to which the carbon filament was attached. At the outset the price of the lamps was very high, some few being sold for as much as a dollar, or a dollar and a half each, but as soon as the industry was placed upon a manufacturing basis the price settled to 35 cents. The reduction of the average selling price to 15 cents at the time of this report has been due to a great many radical changes as well as to the increase in the volume of production; but in structural features the lamp has remained the same throughout.

Mr. John W. Howell, who has been an expert in this field from the beginning, has noted the chief changes in conditions governing the industry, which at the outset was based almost entirely upon manual operation, or required the invention of new machinery.

The lamp of 1880 and 1881 contained about thirty times as much platinum in leading-in wires as the lamp of the present day. The amount and cost of the glass and other materials used have also been greatly reduced.

The exhausting of lamps by mercury pumps required from four to six hours in 1881. Improvements in pumps and methods reduced the time to half an hour in 1895, and since then, with the single piston pump and "chemical exhaust," only one minute is necessary for even better results. At the end of 1882 the cost of exhausting a lamp was considerably greater than the total cost of a lamp at the present time. All the glass blowing operations have been changed from handwork by skilled glass blowers to machine work by unskilled labor, and the labor cost of the present glass operation is now only a little more than 10 per cent of what it was in 1882.

The photometric methods and apparatus employed in testing the lamps before sending them to the consumers have been remarkably improved and developed; the cost of photometric measuring is now only 9 per cent

EDISON LABORATORY AT MENLO PARK, 1880, SHOWING POSTS FOR OUTDOOR INCANDESCENT LIGHTING.

Incandescent lamps here used were connected with underground multiple or parallel circuits.

of what it was in 1882, and this decrease in cost has been accompanied by a great gain in accuracy and evenness in output. The greatest production of lamps reached at the Edison Menlo Park factories in 1882 was a thousand lamps in a day of twenty-four hours, for in those days it was the habit to have the work carried on continuously.

By 1894 many manufacturers had given up the bamboo or vegetable fiber filaments, and cellulose came to be almost wholly used. One of the first workers in this country to experiment with this material and to employ it successfully for commercial lamps was Mr. Edward Weston.

While this report has been in preparation, metallic filaments have been introduced, as, for example, those of the metal known as "tantalum."

Some of the very earliest carbon filament lamps were those supplied by Mr. Edison to Mr. Henry Villard for the steamship *Columbia*, plying on the Pacific. These had paper filaments and consumed about 100 watts of energy in furnishing a light of 16 candlepower. At the present time, the standard 16-candlepower incandescent lamp consumes only 50 watts. The useful life of a 50-watt lamp is undoubtedly longer than was the useful life of a 100-watt lamp in 1880, while the estimated useful life of a 100-watt 16-candlepower lamp made to-day is over 10,000 hours, or about twenty times as long as it was twenty-five years ago.

In the last quarter of a century a total of over 250,000,000 lamps has been produced, or not less than 10,000,000 a year.

III.

DEVELOPMENT OF COMPLETE SYSTEM OF ELECTRIC LIGHTING.

Edison's work.—The development of the incandescent lamp was associated, in Mr. Edison's mind, with the creation of a complete system of electric lighting, the current to be furnished from a central station to a large number of buildings in a manner exactly analogous to that in which the supply of gas was furnished. With this end in view, Mr. Edison experimented with dynamo electric machinery, and brought out new types of machines intended especially for use in this work. The chief aim was that the machine should have massive and powerful field magnets and that at the same time the resistance of its armature should be extremely low as compared with the combined external resistance of the supply mains and lamps, so as to enable current to be produced and distributed more economically than had hitherto been possible. In other words, Mr. Edison realized the commercial necessity of having the armature of the dynamo of low resistance as compared with the external resistance of the circuits, in order that a larger percentage of the electric energy developed, should be available for utilization in the lamps. General practice prior to that time had been to employ dynamos of high internal resistance as compared with the external circuit. The Edison idea, broadly stated, was to employ lamps of very high resistance operated in parallel or multiple arc, instead of in series, and dependent upon current of constant potential.

In the summer, fall, and winter of 1880, Mr. Edison installed such a system at Menlo Park, lighting the houses, streets, laboratory, machine shop, etc., with 425 16-candlepower lamps, the out-of-door lamps being mounted on short poles. The average resistance of the lamps used was 110 ohms and the electro-motive force of the current varied from 95 volts for lamps at the outer ends of the supply conductors to 110 volts for the lamps nearest the dynamos. The circuits were underground conductors, a system to which Mr. Edison has always adhered, not only because of the obvious difficulty there would be in carrying overhead the large mass of copper necessary for low voltage constant potential lighting, but because he believed that with the conductors underground there would be attained the constancy of service without interruption which is obviously necessary for all central methods of artificial illumination. The current for this interesting pioneer plant was generated by ten 8-horsepower dynamos, the field coils of which were connected in series and excited by a separate similar machine.

Use of steam engine developed.—No special attention up to this time had been given to the development of a steam engine of close regulation, which would maintain under wide fluctuations of the load the proper potential of current, so as to prevent flickering in the lamps; and the original workers, like Mr. Edison, in this field, had to take the engines that the market offered. These dynamo machines at Menlo Park were driven by an old-fashioned slow speed engine, widely and favorably known for stationary power plants. In order to obtain the necessary speed for the armature rotation there was no alternative but to connect this engine with the dynamos through a complicated and cumbrous system of countershafting which was highly wasteful of power. Mr. Edison thereupon conceived the idea—bold for that day, but now universally adopted—of substituting one large single dynamo for the several small machines and of connecting this directly with the driving engine on the same base, thus securing the requisite high armature speed without separate belting, shafting, and countershafting, and making possible closer regulation as well as various economies of space and such benefits as attend large production as compared with small.

Several of these Edison "Jumbos" were produced and used in this country and in Europe. Some of them continue in operation at the present time. One was shown at the International Electrical Exposition at Paris in 1881, where its appearance was looked upon as a notable technical and historical event and where with its capacity of 700 lights its size excited wonder. To-day it is reduced to insignificance in comparison

with machines that supply current readily to 70,000 lights, in many of the Edison central stations.

In the early eighties a great many radical improvements were made; the apparatus devised toward the close of the preceding decade had remained crude, needing use and the lapse of time to eradicate the defects and develop the necessary lines of perfection. Such work included the elaboration of the three-wire system by Edison and Hopkinson and the work of Weston in the refinement of continuous current constant potential dynamos.

Attempt to unify arc and incandescent lighting.—The two systems—arc lighting and incandescent lighting—were still wide apart and remained incongruous in their essential elements: Arc lighting with its high voltage and large units of light was suited, in reality, only for exterior use, with lamps scattered; while the incandescent system with its low voltage, large amounts of copper in the circuits, and small units of light was limited almost entirely to indoor service. Thus the two systems, while growing side by side, were irreconciled in a technical and engineering sense, and although their two fields of employment could hardly be said to overlap, the competition and rivalry that developed between the persons interested were literally of a ferocious character. Despite personal and financial antagonism, however, the underlying necessity led to many efforts to harmonize the two methods of lighting, and for some years inventors attempted to introduce compromises in the shape of composite hybrid systems that would bridge the gap between the series and multiple forms and methods of the industry. Some of these contrivances were highly ingenious, but their temporary character was soon proved, and thus the way was clear for the introduction of the modern alternating current system, which more than any other factor has simplified and unified the field of electric illumination as well as that of power transmission, as it exists to-day.

Development of use of the alternating current.—A very interesting review of this development has been made by Mr. William Stanley, jr., who was foremost in this department of work in the United States. In 1883 an inventor named Gaulard brought out in Europe a system of operating induction coils in series by means of which the high potential current of an alternating current generator could be delivered as low potential currents, through the induction coils, on local circuits and at the point of consumption, so that the advantages of economical high voltage transmission, as in arc lighting, could be enjoyed in association with the no less important advantages of the safe low potential current on the premises of the consumer, as in the existing methods of incandescent lighting. There was the further great advantage that arc and incandescent lamps and motors could be supplied with current from the same common source and from the same machine. Gaulard proposed to place a series of his "inductoriums" or open circuit magnetic transformers in a line, connected with his alternating current generator supplying a constant current, and he showed that if these were made open circuit with a very high mutual induction between the primary and secondary coils, and if the current from the generator were constant, each induction coil would give a correspondingly constant potential on its secondary circuit throughout all variations of resistance in that circuit; such, for example, as variation in the number of lamps turned on or off. Following out these principles a great deal of interesting work was done with a system known in Europe and this country as the "Gaulard-Gibbs," but it was soon found to be wanting in many of the essential requirements of a general practical lighting system.

Mr. Stanley himself took up the subject in 1883 and 1884, with particular reference to alternating current distribution which would be inherently self-regulating. After producing a number of induction coils, or, as they are now called, transformers, he sought in 1885 to secure assistance in the exploitation of an alternating current system in which the transformers should be arranged in parallel or in multiple arc and operated at a constant potential. In that year he hired an abandoned rubber mill at Great Barrington, Mass., and began to devise an operative self-regulating system. He borrowed for this purpose a Siemens alternating current dynamo and built about a dozen transformers, each of which was wound so as to reduce the main line potential from the dynamo to 100 volts in the secondary circuits to which the lamps were connected. In the spring of 1886 the dynamo was set up and connected with the transformers that were installed in some of the stores in the village of Great Barrington, where they were put into service on a regular commercial basis.

The transformers were naturally of crude design and workmanship, the primary and secondary circuits being separated from each other only by shellacked paper and other substances of equally fragile nature. But they stood up excellently under the test. As a matter of fact, this system was operated on the double conversion system, which is to-day so familiar in power transmission enterprise. In this system the 500-volt primary electro-motive force of the generator could be transformed or "stepped up" to 3,000 volts by "raising" transformers in order to increase the distance of the regular line transmission and reduce the amount of copper in the main line circuits. The 3,000 volts could be taken by the local transformers and reduced to 500 volts; and again "stepped down" to 100 volts for the distributing circuits. This system was seen in operation by Mr. George Westinghouse in 1886, and he soon made it the basis of a great electrical and industrial development, beginning with the first regular alternating current station at Buffalo, N. Y., in the fall of the same year.

A great many elements, particularly the development of alternating current dynamos, or alternators, were

still necessary, however, to make the system a commercial success. Mr. Stanley perfected an alternating current dynamo designed to give a potential of 500 volts with the possible minimum drop of pressure between no-load current and full-load current. Upon tests at Pittsburg, at the predetermined speed and exciting current, the electro-motive force of the machine was 490 volts instead of 500, and fell off less than 5 per cent when the load was increased from the minimum to the maximum full-load.

The difficulties attendant upon all this work may be gathered from Mr. Stanley's own statement: "It is remarkable how little of modern electricity we all knew in those days. The terms inductance, self-induction, armature reaction, transformer, converter, single phase, multiphase, hysteresis, and a number more were unknown. When we saw phenomena that we did not understand we had to try and fit some sort of names to them. It was some years later before the art was ready for high potential work, for it was necessary that the alternating machines, the transformers, and the system devised should attain a certain degree of perfection before engineers dared to introduce the idea of serving electricity over great distances by means of very high potentials, as the profession understood that term."

The induction coils or transformers thus developed—the work of Mr. Stanley being quickly rivaled by that of many other American inventors, prominent among them being Prof. Elihu Thomson—are now an essential feature of a very large proportion of electric lighting work and power transmission in the United States.

When the circuits are carried overhead in suburban or rural districts, it is a common thing to see the transformers mounted on the poles which constitute part of the overhead system, the wires from the main circuits being tapped into the top of the transformer and the wires from the secondary circuit to the local points of consumption being tapped out of the lower part of the transformer. These devices are of varied type, known principally by their distinguishing names, such as "core transformers" and "shell transformers," while the additional descriptive phrases "air-cooled," "water-cooled," and "oil-cooled" are also used. In the transformer of the core type, the magnetizing core is usually built up of rectangular punchings of soft sheet iron about one-twentieth of an inch thick, with the primary and secondary windings of copper wire around the core or in efficient juxtaposition thereto. In some types of shell transformers, primary and secondary coils are partially or wholly surrounded by the laminations of the iron core. The coils are generally so arranged that they can readily be connected in series, or in parallel, or in other relation to each other, so as to vary the ratio at which the incoming generator primary current is transformed into the outgoing secondary consumption current.

In the early days the transformers were quite small, equal to supplying current to only a few lights, but of late years the tendency has been toward the construction of larger transformers on account of their high efficiency; and some of the units are of several hundred horsepower capacity. These larger transformers are necessarily not placed on poles, but are sometimes placed in cellars or basements and very often placed in separate buildings known as "substations." If the alternating current is to be converted into direct current, they are associated with dynamo electric apparatus known as "converters," and often with storage batteries in which part of the current delivered from or to the line can be stored until needed.

These larger transformers develop a considerable amount of heat and are kept cool in one of three ways—by oil, by air, or by water. In the oil transformers the case of the transformer is virtually an oil tank in which the entire core and coils are immersed, the circulation of the oil acting to equalize the temperature and to carry the heat to the case from which it is radiated, such case being made with external ribs or corrugations, so as to increase the radiating surface. The transformers, in which the cooling is effected by means of air, often by means of a forced draft, are supposed to have advantages over the oil-cooled type, as the cooling effect can be regulated in accordance with working conditions and there is an avoidance of possible danger from fire in case of a short circuit inside the transformer or the sudden scattering of the ignited oil. A well-built, oil-cooled transformer should not increase in temperature beyond 125° and water-cooled transformers, if well constructed, should not increase in temperature beyond 122°. Some of the water-cooled transformers are also oil filled. A continuous flow of cooling water is kept up, either through a water jacket in the casing, through hollow conductors, or through pipes immersed in the oil.

Later arc lamps.—For many years a large part of the arc lighting of the country was done exclusively by means of direct current constant voltage lamps, but the greater vogue of the alternating current has renewed and developed the utilization of lamps of the alternating type. The two classes of lamps have distinctive features. In the direct current lamps the positive carbon is the upper one, and is that from which the current flows to the negative or lower carbon, the cavity or crater of the arc being formed in the upper carbon. In alternating current arc lamps, however, each carbon becomes alternately positive and negative, and if the reversal of the current was not very rapid there would be visible periods of light and darkness or an equivalently disagreeable fluctuation. The frequency of the alternations must therefore be high in order to overcome this feature, and in practice it has been found that with 60 periods or cycles per second—that is, 120 alternations of current—the light is quite steady, so far as

the eye can determine. Even with slightly less than this the light appears steady, while with a proper frequency and proper mechanism the alternating current arc compares favorably as to apparent steadiness with its direct current competitor. As a matter of fact, alternating current arc lamps have come into use on both constant potential and constant current circuits, and their presence can usually be detected, if not otherwise known, by the slight humming sound that proceeds from them as a result of the variations in current strength during each cycle which set up corresponding vibrations in the surrounding air. Direct current arcs of nominal 2,000 candlepower require ordinarily about 10 amperes of current and a pressure of 45 volts between the carbons. Alternating current arcs require about 15 amperes at a pressure of from 30 to 35 volts.

Change from open to inclosed lamps.—A further development in arc lighting during the past few years has been the employment of "inclosed" arc lamps. It has not been an uncommon thing, ever since the beginning of the modern arc lighting, to see arc lamps burning without a shield of any kind between the arc and the eye. This is particularly the case in such places as rolling mills or open spaces where the glare of the arc is not offensive and where the flying sparks from the carbons do not create any fire hazard. In general practice, however, "open arcs," as they are called, have always been inclosed by globes of glass, open generally at the top, and if indoors, they have been equipped with spark arresters. Instead of globes, panes of glass were sometimes used. Whether in globes or panes the glass was usually ground or opalescent instead of clear, so as to mitigate the glare.

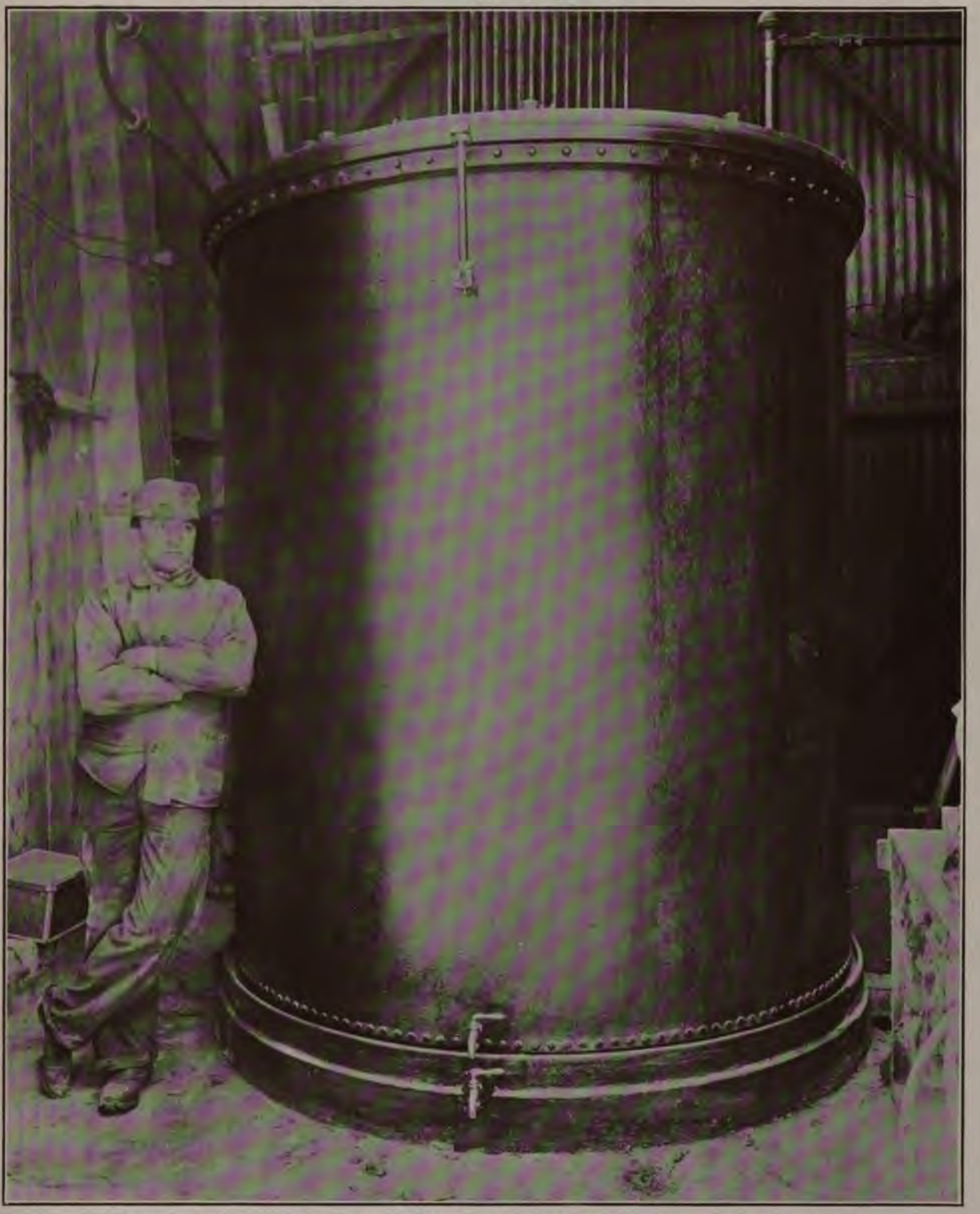
The use of inclosed arcs was a notable step. Since 1894 the open arc has been very generally superseded by the inclosed arc, so that to-day the inclosed type is manufactured almost to the entire exclusion of the open type. In regard to this subject, Mr. L. B. Marks, a leading inventor in that field, says: "Those who are familiar with the steps in the evolution of the inclosed arc lamp of commerce know that this type of lamp was made possible by the discovery that when the arc is inclosed in a small globe having a suitably restricted air inlet a long arc of abnormal voltage may be steadily maintained by a small current—a condition impossible in free or open arcs. This discovery was followed by the construction of a lamp that would strike a long arc and maintain it under the proper conditions. Herein lay the secret of the modern inclosed arc lamp. Broadly speaking, that secret was not in the carbon but in the arc. The solution of the problem therefore involved, first, a method of operation, and second, apparatus for carrying out that method. So far as the records go, neither the method nor the apparatus was known to the world prior to the year 1893. Once these features were given to the art the commercial inclosed arc lamp became an accomplished fact."

The carbon in an ordinary open lamp burns away in a few hours, say ten or twelve, but in an inclosed lamp the homogeneous carbons will last from 60 to 125 hours, although what are known as "cored carbons," with a pencil of softer carbon as the core, are employed, on account of the steadier and smoother burning insured. The small inner globe inclosing a portion of the carbon pencils is virtually air-tight, and is made of refractory glass so as to resist successfully the intense heat of the arc; such inner globes are of an elongated egg shape. The consumption of the carbon in the arc in the inner globe results in filling the little bulb with carbon monoxide and carbon dioxide, which in turn shortens the arc to a length of about three-tenths of an inch and permits a pressure of 80 volts to be employed. It will be readily understood that under these conditions an increase in the life of the carbons takes place, all the oxygen of the air having become combined with the carbon and no fresh air or oxygen to help waste the carbon away being admitted. The carbons in the inner globe burn with a crater somewhat different from that seen in open lamps, the crater being broad rather than sharply pointed. Although the pressure in an inclosed lamp is increased from 45 or 50 volts up to 80, the actual consumption of the current is not greater, since but half the current strength is required.

These lamps not only are desirable for street illumination, but also have become popular for interior purposes on account of the agreeable appearance and effect of the inclosed arcs, the excellent distribution of light, and the softness of the illumination, and because of the fact that the complete inclosure of the arc reduces the fire hazard from flying carbon sparks to an absolute minimum.

Perhaps the greatest recommendation to electric lighting companies for the adoption of the inclosed arc is the fact that the labor of trimming is reduced so materially by them. In the earlier days, with open arcs, a large number of men were required for the daily trimming of the lamps, and as the carbon pencils were not wholly burned away, and the remnants were too small to carry back to the station, it was not uncommon to see the fragments wasted and scattered about the streets. Inclosed arc lamps of the modern type, however, need trimming only once a week or once a fortnight, according to the daily hours of burning, and the carbon points are very thoroughly consumed.

A large number of alternating current arc lamps have gone into use in the last few years, requiring further modification of the inclosed arc practice. In such lamps the lower carbon is necessarily consumed about as rapidly as the upper, so that in inclosed alternating lamps the globes have to be made a little



AN OIL FILLED WATER COOLED 1,500 K. W. ALTERNATING CURRENT TRANSFORMER IN USE AT NIAGARA FALLS.

longer so as to allow the use of a longer negative carbon than is necessary in direct current lamps. With 6 inches of negative carbon in an alternating current inclosed lamp the supply is sufficient to keep the lamp burning for eighty or one hundred hours. In order to utilize such lamps in series, constant current transformers are necessary and have been introduced. These transformers maintain a constant current strength, no matter how many lamps may be cut in or out on the circuit, and are so arranged that the mechanism automatically adjusts the distance between the primary and secondary transforming coils, thus keeping the current constant. These "tub" transformers are located at the central station and will carry as large a series of lamps as would one of the familiar arc lighting dynamos of the old régime.

The general extent of the change from open to inclosed arcs may be inferred from the fact that, according to the returns of the Census Bureau in 1900, over 150 cities in this country had then replaced open arcs with those of the inclosed type, and 51 of these cities had permanently adopted arc lights of the inclosed type. Further segregated figures as to the trend of the development were presented at the same time, showing that of the 158,187 lamps manufactured in 1900 only 23,656 were of the open type, so that at that time the annual production of the inclosed arcs was six times as great as that of the open arcs. This tendency has been intensified in the period that has since elapsed. Moreover, as to street lighting, it is noteworthy that in that year some work was done with direct current series inclosed arcs in 73 cities, while in no fewer than 326 cities it was done with series alternating inclosed arcs, deriving current from constant current transformers.

Production of lamp globes.—The production of globes for arc lamps has developed into a considerable industry, the renewal of such globes being a large percentage of the cost in the operation of the lamps. These globes have been given a great variety of shapes and have been made with clear glass and with opaque glass in various degrees of transparency. Sometimes the globes have been made partly clear and partly opaque or ground. The relative position of the two portions depends upon the use of the lamps. For show window use or on bridges, where it is desired to illuminate the roadway but to intercept the beams that might dazzle the navigator on the stream below, the clear and shaded portions have been arranged vertically.

Another type which has come into general use alike for arc and incandescent illumination is the holophote, which is made entirely of clear glass, but has the outer surface molded in the shape of hollow prismatic rings. The inclination of the ring is different at various points of the globe so that the light striking the upper part is reflected downward, and that striking the other ring emerges from the globe either horizontally or in a direction below the horizontal lines. A still better effect is obtained by ribbing the globe vertically also.

A great many of the interesting developments and features connected with arc lighting and arc lighting fixtures pertain more particularly to searchlight projectors, focusing, and light house work, and are therefore not considered within the range of this review.

Lamp supports.—During the earlier years of electric lighting there were no suitable appliances and appurtenances for supporting the lamps. High poles or iron framework towers were used in the first attempts to display arc lights out of doors. The ring of lamps at the top was sometimes lowered in order that the lamp might be recarboned, although it was a general practice for the linemen to ascend the tower to attend to the trimming. These tower supports were extensively adopted in the cities of Cleveland, New Orleans, Detroit, and New York, and also on the Pacific coast, and by this means an agreeable, well-diffused light, comparable to soft moonlight, was afforded. Such illumination was soon found to be expensive and where the streets were overhung by shade trees quite ineffective in summer; hence resort was soon made to short poles similar to those employed in gas lighting.

Poles of wood, iron, and steel have remained a permanent feature in the industry whether overhead wires or underground circuits are used, and of late years there has been a perceptible gain in their appearance from an aesthetic point of view.

Another method of suspending arc lamps having considerable vogue is that of placing them at street intersections across the roadway, the lamp being held up by cross suspension wires from poles on either side of the street. Another form of support is that known as the "mast arm," consisting of an arm carried at right angles to the pole and projecting outward over the roadway. On these last two forms considerable energy has been expended to secure safe and easy methods of lowering and raising the lamps to trim them.

Still another method of placing arc lamps is that of carrying them on brackets suspended from side walls. A great deal of energy has also been expended in the production of hoods, cut-out switches, shades, and reflectors for the better and more economical distribution of the light. In some instances in interior illumination the arc lamp has been inverted, the shade coming below the arc instead of above it, so that the rays are reflected upward to the ceiling, and a very good diffusion of light is thus secured.

Series and multiple methods.—The development of incandescent lighting with circuits carried into dwellings, public buildings, and interiors of all descriptions called for many subtleties and refinements far beyond the province of arc lighting, and this field has been peculiarly prolific of inventions and improvements. It was not sufficient to invent and perfect an incandescent

lamp, nor to produce dynamos to furnish the current, nor to devise means for the installation of the copper circuits connecting the generator with the lamps.

The original series arc lighting system was what may be called a one-wire system, that is, the lamps were distributed along it like beads along a necklace, the dynamo being the clasp, from one end of which the circuit started and to the other side of which the circuit returned. Incandescent lighting work began with a two-wire system; two main wires running out from each side of the dynamo and continuing, free ended, the lamps being placed in circuit across or between them like the rungs in a ladder. In view of the low voltage employed the two-wire system necessitated the use of large quantities of copper, and this led to the development of the three-wire system, in which two dynamos are employed with three mains or conductors, that which may be called the "middle one" serving as a common return for the two outside wires. By the use of this method a saving amounting to over 65 per cent could be made in the total weight of copper required to deliver the current as compared with the amount of copper necessary in the two-wire system. These methods have been refined and developed so that four, five, and seven wire systems have been introduced, all aiming to reduce the amount of copper in the circuits while maintaining the advantages of the multiple low voltage distribution. It must not be overlooked, however, that, as in most cases of this kind, there are some drawbacks resulting from the complications and additional appliances introduced into the system. Incandescent lighting as a rule is now practiced on the two and three wire methods.

Appliances.—In addition to the distributing system a great variety of detail appliances had to be devised, including meters, fixtures, switches, cut-outs, and safety fuses. Some of these instruments are necessary for the registration of current as it flows out of the central station, while others are required at the points of consumption. In the earlier days of the industry scarcely anything was known of exact measurement, but to-day both the absolute electric units and the practical electric units have been determined and fixed by national and international agreement, and there is no field of scientific or engineering work in which results or determinations are arrived at with more careful precision.

As a general thing arc lighting has not been complicated by consumption measurement, the instruments in use being those located at the central station to indicate to the attendants in a simple manner the maintenance of the dynamo amperage at a constant point under all variations as to the number of lamps on the circuit. With incandescent lighting and the sale of electric power, a large variety of instruments and meters have been called for and are now in use. A brief discussion of meters was given in the article on electric apparatus and supplies as presented in the Census report of 1900.[1]

For central station use many varieties of indicating instruments and meters have been devised, and the switchboards upon which they are mounted, and to and from which the circuits are led, are to-day elaborate and costly. Some boards in large plants attain a length of 40 or 50 feet, and cost, with their instruments, marble or slate bases, copper bars, brass trimmings, and other paraphernalia, a great many thousand dollars.

In addition to the instruments in use by central stations and their customers, a large number of portable types have been devised for electric lighting and power transmission work so that tests may be made "out on the line" at any point on the circuit where trouble may arise, or where it is desired to determine certain conditions. There are a great many varieties of such portable testing sets, an ordinary type of which will include what is known as a "Wheatstone bridge, galvanometer, battery, and keys." The battery consists of a few chloride of silver cells.

A general classification of measuring instruments in common use would include the electro-magnetic, the electrostatic, the electro-chemical, the electro-thermic, the tangent galvanometric, the dynamometric, and the D'Arsonval and Weston types. Some of these devices indicate visually. Others, by means of magnets or electro-magnetic action associated with clockwork escapement, record results subject sometimes to a certain "constant" for exact correction.

Electrostatic instruments are in use to some extent for high tension measurements and as ground detectors, etc. These depend for their action upon the mutual attraction of two plates connected with the opposite sides or poles of the circuit when any difference of potential exists between them. If one of these plates or conductors be fixed and the other free, the free one will be attracted to the one that is fixed and thus indicate the amount of tension. Some beautiful apparatus of this character is manufactured by large concerns in America, especially for circuits carrying currents of 10,000 volts and upward, the readings of which would be difficult to secure with precision otherwise.

Other measuring instruments like those in the electro-chemical or voltameter class depend upon the amount of metal, such as silver, deposited by the action of the current in a small cell through which a definite portion of the current in the consumption circuit is made to flow, the plate being weighed periodically.

When Mr. Edison began his incandescent lighting he designed and brought out a voltametric or electro-chemical meter which remained in extensive use for a long period, its indication depending upon the transfer of silver from one small plate to another. Although in Europe meters of the voltametric type have again

[1] Twelfth Census, Vol. X, page 198.

found some favor, they have been very little used in the United States of late years, and the Thomson wattmeter and others of the same class, like the Shallenberger, have had the greatest vogue. These are either essentially small motors or are based upon the revolutions of a moving part which actuates the registering escapement.

The electro-thermic instruments depend for their action upon the principle of expansion by heat, the expansion of a fine resistance wire or strip of conducting material being proportionate to the square of the current passed through. This principle is applied in various ingenious ways. For example, in one instance in consumption service, the meter is a glass tube with two bulbs, around one of which the conductor is coiled. The passage of the current in the coils heating the air in the one bulb forces some of the liquid out of it into the other and into an overflow tube, where it remains until the meter has been read and tipped back again for another turn of duty. This meter makes possible the grading of the charges for current according to its use. Thus a large consumption of current will cause a correspondingly large quantity of liquid to pass into the overflow indicating tube, while a lesser current will cause either a small quantity or none at all to pass off; so the consumer benefits by the application of a scale of charges which encourages his liberal use of current, such a scale being applied, moreover, scientifically instead of arbitrarily.

Central station ammeters and voltameters have in more recent years come to be largely of the Weston and D'Arsonval type. The broad principle of these is that a coil suspended in a magnetic field between the poles of a magnet will rotate through a small angle when the current passes. The swing of the coil carries a needle attached to it over the graduated face of a dial, on which are legibly indicated the figures to be watched or noted by the attendants. In case large currents are to be measured by this instrument, shunts are employed so that only a small part of the current goes through the coil. Weston instruments of this type have become standard the world over and are largely exported.

Fixtures.—When the incandescent lamp was first introduced there were no fixtures for it, and the first "electrolier" was nothing more than a gas chandelier, around which the wires to the lamps were twined, the sockets of the lamps being fastened just below the gas burner outlets. It was thus demonstrated that the incandescent lamp could be burned upside down as well as in any other position, and special fixtures were soon brought out, many of them of a high standard of artistic merit. Improvements, due to Mr. Luther Stieringer and others, next allowed the wires to be carried with safety within the stem of the gasolier or chandelier, and the combination fixture, burning both gas and electricity, thus became a permanent feature.

In 1881 the residence of J. Hood Wright in New York city was lighted with Edison electric incandescent lamps, and most of the lamps, with the exception of those in fixtures, were protected by individual fuses, the object of which was to cut off the flow of current by fusing, should the proper amount be exceeded. The fixtures carrying more than one light were protected by placing fuses outside or safety catches within the canopy at the top of the fixture.

Fusible cut-outs on the lamps attached to flexible cords were first used at the Mechanics Fair in Boston in 1882. No ceiling construction for flexible pendants had hitherto been used, and at this fair five such pendants were employed, made of ordinary cotton covered cord, like that used in men's suspenders, sewed into a flat strip. The earliest regular flexible conductors for incandescent lamps were made for the Louisville Exposition in 1883 and consisted of ordinary cotton covered with an insulation.

Out of this early and cruder practice have grown the methods and fixtures in use to-day. The fixtures are now made in an infinite variety of shapes and forms, but consist essentially of six distinct groups: The simple drop or pendant lights with adjusters to regulate their height from the ground; the portable lamp, which can be carried around freely and plugged into any wall receptacle for contact with the supply circuit; the special small fixtures for desks, tables, lecterns, etc.; the side or bracket fixtures made for single or clustered lights; the fixtures for entrance stairways, "isles of safety," etc.; and the whole range of small and large electroliers, some of which, as those in the Metropolitan Opera House and in the St. Regis Hotel, in New York city, carry hundreds of lamps in special group sockets.

The lamp socket itself has undergone a course of evolution and choice has gradually narrowed down to one or two specific types of simple design. The lamp is secured to and contacted with the screw socket by metal plates in the base of the lamp and of the socket and by contact between the shell of the socket and the brass cap of the lamp. In some of the earlier forms of the socket and lamp, the lamp was held in place by means of a bayonet catch in the socket and a peg on the lamp, but this method has virtually disappeared. For out-of-door use, or for places where the lamps are exposed to the elements, ingenious forms of weatherproof sockets have been worked out. These are largely needed for special and regular street illumination, and at expositions and fairs on the illuminated towers, arches, etc., these being nothing more than fixtures on a large scale, which combine in a brilliant and attractive manner the elements of electrical manufacture with those of architectural construction and artistic proportion.

Fuses and cut-outs.—The fuses and cut-outs used in electric lighting also have undergone a remarkable process of evolution. For many years past fuses have consisted of short pieces of fuse wire or metal strips

inserted at predetermined points. The fuse wire and the copper wire circuit guarded by it will carry the normal amount of current for which the circuit has been calculated, but if undue current comes on the circuit the fuse wire, which has a much lower melting point than the copper, gets hot much sooner and melts or "lets go," so that the circuit is interrupted before damage is done or before a fire can ensue. Service on the circuit can not be resumed until another fuse has been inserted by hand, although in some automatic forms the fuses are put up in "barrel" or reservoir fashion, so that a new fuse can be dropped into place automatically. These safety devices are made usually of an alloy of tin and lead, and are of a certain fixed diameter and carrying capacity, in accordance with specified insurance and engineering rules. These fuses are set on slabs of porcelain, slate, etc., and are boxed in so that the melting metal can not be spattered around, the covering being either of porcelain or of some transparent material, like mica, permitting examination of the interior parts.

The later developments include fuses of the inclosed or cartridge type. In one form of these fuses the inclosing tube is filled with a material intended to stifle the fire or arc caused when the fuse "blows" or is melted. In other forms the filling material is so employed as to leave part of the fuse uncovered, an air chamber or vent being thus afforded so that the rush of air may assist in extinguishing the arc. The filling material consists of chalk, asbestos, potash powder, etc. These inclosed fuses are usually made up in a stout paper jacket of cylindrical form with metal ends, and in some instances they have a small target or disk on the interior of the paper shell which becomes discolored when the fuse is "blown," and in this way indicates when it should be renewed. These inclosed fuses are applied more particularly to larger circuits carrying current in some appreciable volume, and the simple fuse cut-outs or safety catches are applied more particularly to a single lamp or a group of a few lamps.

Methods of wiring.—The use of electric lighting for interior purposes has led to the development of improved methods of wiring, with the object of securing a maximum of safety and accessibility to the circuits. The first interior circuits for incandescent lighting purposes were bare wire. Then came insulated wire carried along the ceilings or walls by means of cleats, leaving the wires exposed between the supporting points. At the same time molding nailed to the walls or ceiling was used and the wires were concealed in grooves inside the molding. Practically all the primitive incandescent lighting was done in this crude manner. The next step was the location of insulated wires and cables in the plastering of walls, a sheathing of lead being frequently added to the insulated wire for greater protection.

Wiring exposed by means of cleats has been found to have elements of safety, for the exposed wires can radiate quite freely the heat due to resistance; but on the other hand they collect dust and moisture from which incipient short circuits follow, as a result of the bridging between the two parallel wires. Wiring in molding has come to be regarded as dangerous because its concealment prevents prompt discovery of deterioration, while the fact that the wires are entirely incased prevents the radiation of heat and tends to cause fires by the ignition of adjacent woodwork. Wires embedded in plaster and thus removed from contact with inflammable material have elements of recommendation, but it was soon found that in order to get at the wires thus embedded, the destruction not only of walls but also of costly decorations, woodwork, etc., was frequently involved.

These four methods have practically died out, or, if permitted in modified form, are subjected to severe restrictions by the underwriters and other authorities. Some wiring also has been done by means of metal staples or wooden fiber cleats, and has therefore been of a most temporary character. The insurance rules recognize only porcelain cleats or insulators for interior work, with the wires 2½ inches apart and at least one-half of an inch from the surface of the wall or ceiling.

Several years ago Mr. E. H. Johnson, one of the pioneers in incandescent lighting, came to the conclusion that electric wiring should be as exact in its methods as water or gas piping, and began the development of a system of interior wiring, the objects of which were a definite location for the wires, facilities for removal or renewal, prompt accessibility, and a minimum danger of fire. From crude beginnings the approved modern method of carrying all the interior wires in conduits developed.

The first conduits employed in this class of work, although quite primitive in character, being composed of stout paper or fiber, twisted spirally into a tube and then asphalted to render it waterproof, marked a great step forward. It was soon found that these paper conduits were not sufficiently strong to resist wear and tear, and the next step was to give them a metal protection, either by inclosing them in iron pipe or by incasing them with metal ribbon, such as brass, wound spirally around them. This practice has developed into two standard types of conduits: One being the insulated metal conduit with an interior insulated lining, having a wall not less than half an inch in thickness, so smooth as to allow the wires and cables to be drawn through easily, but tough enough to resist the abrasive effect of such work; the other being the uninsulated metal conduit, consisting of plain galvanized iron or steel pipe with a smooth inside finish or with the inner surface coated or enameled, so as to permit easy passage of the wire. Where such bare metal is used the best practice is to employ an insulated wire with superior insulation. Other types of conduit, however, in which metal is not employed are recognized

and permitted by the underwriters. These conduits are usually of woven textile fabric, heavily saturated in insulating material, the wall presenting almost as much resistance to crushing pressure or to the attack of nails or edge tools as though it were of metal.

Thus, instead of the wires being placed haphazard or "fished" loosely in between walls and partitions, wiring is now accomplished on a definite plan, with the conduit in definite places leading to the proper switches, junction boxes, and panel boxes, and the slight added cost of the conduit is more than offset by the gain in safety and other conditions. Flexible cord, by means of which a lamp or fan motor or other device can be carried from place to place, is still in considerable use, however, and probably will remain so for extension lighting.

Insulated devices of nonabsorptive or noncombustible material are required in a great many special places and for a great many uses. Circuits carried into wet or damp places, such as chemical works, breweries, and dyehouses, are peculiarly susceptible to insidious attack by moisture, fumes, etc., and have to be carefully guarded by means of waterproof sockets and other devices. These precautions are required also in connection with the outdoor use of arc and incandescent lamps, particularly with regard to the advertising signs and decorations now so prominent a feature at night in every large city.

Modern conveniences.—The refinement of modern conveniences in the utilization of current from central station sources of supply can best be understood by seeing in the modern city house the elevators operated by electric motors, electric cooking apparatus and flatirons in use in the kitchen, incandescent lamps and fan motors in the living rooms, and electric curling irons and foot warmers and electro-thermic pads in the bedrooms, all connected by flexible cords and wall plugs to circuits that are brought to them by means of interior conduits, which run back to the main cut-out box in the area vault, where the circuits are tapped off from the street mains.

Novel types of lamps.—During the past few years attempts have been made to break away from the approved and familiar forms of arc and incandescent lighting, and at the time of the preparation of this report there were already in use in large numbers two types of lamps whose future may not be regarded as definitely settled, but for which a special place appears to await.

Nernst incandescent lamp.—The Nernst incandescent lamp differs in many respects from the incandescent lamp proper and from the arc lamp. The long carbon filament of the incandescent lamp is replaced by a short strip of a material which, while it is an insulator and nonconductor at ordinary temperatures, becomes both a good conductor and an excellent illuminant at higher temperatures. This material consists of a mixture including such rare earths or oxides of refractory character as yttrium, thorium, zirconium, cerium, and magnesium. These oxides have a high point of fusion and even when highly heated can be exposed to the air without any perceptible deterioration. Some of this material or mixture is worked up into an incandescent device known as the "glower," which is about an inch in length and one thirty-second of an inch in diameter. When this glower is brought up to incandescence it gives a beautiful white light, each glower being calculated to give an amount of light equal to that of an ordinary 16-candlepower incandescent lamp. The current required by each glower is about 88 watts, and the lamps are operated at an economy of about 1.8 watts per candle, or about one-half of that required by the carbon filament lamp. In order to increase the size of the Nernst lamp, the number of glowers is increased; therefore the lamp may consist of 2 glowers, 3 glowers, 6 glowers, etc.

A great deal of inventive ability has been shown in perfecting automatic Nernst lamps, in which the glower can be heated so as to bring it up to the temperature at which current will begin to flow through it. Generally speaking, this preparatory heating of the filament is effected by means of small heater coils, consisting of platinum wire wound around little porcelain tubes covered with an insulated refractory paste. These are mounted in the lamp in the vicinity of the glower, and when the current is turned on it flows momentarily through the heater, which quickly cuts itself out of circuit and leaves the glower in operation at incandescence. A further lighting device, called the "balance," consists of coils of iron wire placed in series with the glower, thus steadying the current or equalizing its flow so as to offset the sharp decrease in the resistance of the circuit, which is a necessary result of the increase in the temperature of the glower.

The Nernst lamp differs also from the high vacuum incandescent lamp and resembles the arc lamp in that it can be burned without injury in the open air—that is, without any inclosing glass bulb—although in ordinary practice the mechanism above described is inclosed in a white ground glass globe, which prevents too rapid a dissipation of the heat from the glower, which would waste the light giving power, and also protects it from drafts, which would have the effect of making it appear to fluctuate through the variations in temperature.

One objection to the Nernst lamp has been the fact that it has hitherto been found useful chiefly on alternating current circuits and not freely available for direct current circuits; but it is understood that lamps available for both circuits are now on the market.

The mercury vapor lamp.—Another prominent type of lamp for electric illumination still in the early stages is that known as the "mercury vapor lamp," the introduction and commercial perfection of which has been largely due to Mr. Peter Cooper-Hewitt, of New York city, although of late years a number of other eminent

inventors have worked in this field. In the ordinary commercial lamps of this character, of which large numbers have already been introduced, the lamp consists of a glass tube an inch in diameter and 4 feet long, exhausted to a vacuum, with platinum leading-in wires sealed into the two ends of the tube. The anode or positive pole of the tube consists of an iron grid or a small quantity of mercury, and the cathode or negative pole consists of mercury. The lamp is put into operation by either the tilting method or the quick breaking method. In the latter the high potential discharge from an induction coil is employed to break down the high initial resistance within the lamp, this coil being assisted in its action by a starting band of metallic paint around the lamp at the negative end. In the former method, when the current is turned on, the lamp is tipped or tilted so that the stream of mercury trickling down the interior of the tube makes a contact between the two electrodes; when the stream breaks, as the lamp tips back again, the mercury is vaporized, and the mercury vapor or arc being heated to incandescence by the current, emits its intense light. The illumination of the Cooper-Hewitt lamp has not been of a particularly agreeable character, because of the absence of the red rays of the spectrum and the predominance of bluish or yellow-green rays, but the lamp is of high economy and has been found peculiarly applicable for the illumination of large spaces, while it has also been largely adopted by photographers and in photo-engraving establishments on account of its intensity and high actinic value.

One of the best illustrations of the adoption of mercury vapor illumination is to be found in the new building of the New York "Times," where these tubes have been introduced in the composing room at the top of the building and in the pressrooms 55 feet below the street surface. No fewer than 42 of these tubes are thus employed with a consumption of current of 5.46 kilowatts, whereas the original estimate for current for the arcs and incandescents to do the same service was 15 kilowatts. In the press and stereotyping rooms the 26 mercury vapor tubes light an area of 17,000 square feet of floor space as well as 4 large presses installed in a chamber with a ceiling 21 feet in height. In the composing room the light appears to be equally satisfactory, especially as the peculiar quality of the light gives new type a rather dull appearance so that it can be easily read. Up to the present time such tubes have been operated with the direct current only, but lamps for alternating current are also being developed.

Vacuum tube lighting.—A modern and novel contrivance for electric illumination is represented by vacuum tube lighting, or the light produced by the electric discharge passing through tubes containing only air at a high degree of rarefaction. Experiments in this field date back to the beginning of the eighteenth century and have long furnished spectacular phenomena for the investigation of physicists and the amusement of the crowd. Some fifteen years ago, however, Mr. Nikola Tesla developed and exhibited vacuum tubes with which a large amount of useful light could be produced, and since that time other lines of work have been followed out to commercial practicability by Mr. D. McF. Moore. Mr. Tesla has employed in this work his well-known currents of high tension and high frequency, produced chiefly by special forms of generation or induction coils. Mr. Moore has worked along the line of employing ordinary central station circuits and currents as well as low potentials. He developed at first an automatic electro-magnetic brake, consisting of a little vibrator which, when placed in a vacuum, served to interrupt the current suddenly and thus secure the extra current effective within the tube. Mr. Moore also developed special forms of generators to produce high potential currents and other means whereby the effects required could be obtained by the use of current from the street circuits. Beginning with small incandescent bulbs, Mr. Moore developed long vacuum tubes, and has carried his work so far as to illuminate large rooms by means of a continuous vacuum tube run completely around the ceiling, after the manner of a cornice or picture molding. In some of these tubes Mr. Moore has employed a gas of such character or degree of rarefaction that by the application of electric current to the terminals of the tube the gas is rendered luminous by the transfer of the energy from one terminus to the other, the consumption of current, moreover, being economical. These continuous tubes have been made by Mr. Moore as long as 40 or 50 feet, and have been built up in situ by novel applications of the glass blower's art. The light from these tubes is of a cheerful white character and the effect of the bar of light around the ceiling is pretty and effective. Such tubes have been shown in commercial operation since 1896 in various buildings and upon the streets in New York, Newark, and other cities so that now they are a part of the art.

GENERAL TABLES

TABLE 65.—NUMBER OF PRIVATE AND MUNICIPAL STATIONS BEGINNING

	STATE OR TERRITORY.	Aggregate.	PRIVATE OWNERSHIP.																					
			Total.	1902	1901	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890	1889	1888	1887	1886	1885	1884	1883	1882	1881
1	United States	3,620	2,805	106	185	152	178	195	170	129	166	144	161	190	157	198	168	142	127	86	49	43	25	27	7
2	Alabama	25	16	2	.....	2	1	.....	2	.....	.....	.....	.....	2	1	2	2	.....	1	.....	1	.....	.....	.....	.....
3	Arizona	13	13	.....	2	.....	2	1	1	.....	1	.....	1	1	1	.....	1	1	.....	.....	.....	1	.....	.....	.....
4	Arkansas	42	34	.....	5	3	1	2	4	1	3	1	1	1	2	2	3	2	1	1	.....	.....	1	.....	.....
5	California	115	105	1	7	6	14	9	8	6	5	9	2	9	10	5	4	5	1	2	.....	1	.....	1	.....
6	Colorado	48	46	1	6	1	2	5	2	.....	1	2	6	2	.....	4	2	4	5	.....	1	.....	1	.....	1
7	Connecticut	38	35	.....	3	.....	1	2	2	2	.....	1	3	1	1	3	2	1	2	3	4	1	2	1	.....
8	Delaware	8	2	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
9	District of Columbia	2	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....
10	Florida	26	21	3	2	1	1	3	3	1	1	2	.....	.....	.....	.....	1	1	1	.....	1	.....	.....	.....	.....
11	Georgia	43	24	3	4	2	.....	.....	3	.....	1	1	.....	.....	2	4	.....	4	.....	.....	.....	.....	.....	.....	.....
12	Idaho	19	18	5	2	1	.....	2	.....	1	1	.....	.....	.....	2	.....	.....	2	2	.....	.....	.....	.....	.....	.....
13	Illinois	346	264	8	9	18	11	12	16	12	20	13	23	34	23	29	14	5	4	4	3	2	1	3	.....
14	Indiana	180	118	7	3	14	6	8	6	3	5	3	15	9	8	11	3	6	2	3	1	1	3	1	.....
15	Indian Territory	10	10	.....	3	1	2	1	2	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	Iowa	169	131	3	3	10	6	9	6	10	12	11	6	10	12	8	2	8	4	3	4	2	.....	2	.....
17	Kansas	61	50	1	1	.....	2	2	1	1	1	.....	2	2	3	3	5	3	13	7	1	.....	1	1	.....
18	Kentucky	58	50	2	5	5	8	3	4	2	1	4	1	2	2	7	3	.....	.....	.....	.....	.....	.....	1	.....
19	Louisiana	25	15	1	2	2	2	1	.....	1	.....	.....	2	1	.....	1	1	.....	1	.....	.....	.....	.....	.....	.....
20	Maine	52	50	.....	5	1	6	3	1	1	5	2	3	1	.....	1	2	4	8	3	2	1	1	.....	.....
21	Maryland	32	27	2	1	3	2	2	1	.....	1	2	2	3	2	.....	2	2	.....	.....	.....	1	1	.....	.....
22	Massachusetts	114	97	.....	3	2	5	4	3	3	4	4	2	2	3	8	14	11	10	10	1	3	2	3	.....
23	Michigan	201	120	3	5	5	7	8	6	4	9	8	4	13	7	10	5	9	8	2	3	3	.....	.....	1
24	Minnesota	138	68	2	4	5	5	8	5	7	7	1	4	2	1	2	3	2	4	1	2	.....	1	1	1
25	Mississippi	43	25	2	4	3	2	4	1	2	1	2	1	1	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....
26	Missouri	123	80	4	3	5	2	6	3	4	6	5	6	5	10	6	5	5	1	1	1	1	.....	1	.....
27	Montana	27	26	2	1	1	1	3	1	2	4	.....	.....	4	.....	2	3	.....	2	.....	.....	.....	.....	.....	.....
28	Nebraska	54	43	4	4	6	2	1	2	1	1	.....	1	4	1	1	3	3	3	2	2	1	1	.....	.....
29	Nevada	5	5	.....	1	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....
30	New Hampshire	51	50	.....	3	1	2	2	5	2	3	5	2	3	5	4	2	3	4	1	.....	1	.....	1	1
31	New Jersey	64	60	2	4	2	3	6	4	2	5	3	4	4	.....	.....	4	6	1	4	1	4	.....	1	.....
32	New Mexico	11	11	1	2	1	3	.....	.....	1	.....	1	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....
33	New York	256	228	6	9	16	13	13	11	19	16	14	13	13	12	5	14	17	14	12	4	4	1	.....	2
34	North Carolina	38	22	3	5	.....	3	1	1	.....	2	.....	2	1	.....	.....	1	2	1	.....	.....	.....	.....	.....	.....
35	North Dakota	21	13	.....	2	.....	1	3	3	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	1	.....	.....	1	.....
36	Ohio	233	145	7	7	2	10	7	10	9	12	5	10	9	7	11	15	6	4	4	3	2	2	3	.....
37	Oklahoma	10	8	.....	2	.....	1	1	1	.....	1	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
38	Oregon	39	33	3	4	2	2	.....	1	.....	2	.....	2	4	1	6	1	3	2	.....	.....	.....	.....	.....	.....
39	Pennsylvania	279	243	1	13	12	8	13	18	3	15	12	20	22	15	27	21	6	8	9	5	7	4	4	.....
40	Rhode Island	7	6	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	.....	1	1	.....	.....	.....	1	1	.....	.....
41	South Carolina	24	16	1	1	1	.....	1	2	1	1	.....	.....	2	2	1	1	1	1	.....	.....	.....	.....	.....	.....
42	South Dakota	28	22	1	1	.....	3	2	1	1	2	2	2	1	.....	1	.....	1	2	1	.....	1	.....	.....	.....
43	Tennessee	54	35	1	.....	1	4	3	4	3	2	2	2	1	.....	1	5	3	1	.....	.....	1	.....	1	.....
44	Texas	137	130	5	20	5	13	18	7	10	4	7	4	6	3	11	5	5	1	3	1	2	.....	.....	.....
45	Utah	16	15	1	1	1	6	2	.....	.....	2	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
46	Vermont	52	41	.....	5	2	1	5	1	3	3	4	4	2	.....	3	2	.....	3	2	1	.....	.....	.....	.....
47	Virginia	37	27	5	2	2	1	1	.....	.....	1	.....	2	1	1	4	4	.....	2	.....	1	.....	.....	.....	.....
48	Washington	40	33	2	6	.....	2	2	1	1	.....	1	1	2	5	4	3	1	1	1	.....	.....	.....	.....	.....
49	West Virginia	41	35	2	4	2	3	1	5	.....	.....	3	1	2	4	6	.....	1	.....	.....	.....	.....	1	.....	.....
50	Wisconsin	152	124	9	3	4	6	14	11	8	4	13	5	4	9	4	8	2	8	6	4	2	.....	.....	.....
51	Wyoming	13	13	.....	2	1	2	.....	1	.....	.....	.....	.....	1	1	.....	.....	.....	2	1	.....	1	.....	1	.....

OPERATIONS DURING EACH YEAR, BY STATES AND TERRITORIES: 1881 TO 1902.

MUNICIPAL OWNERSHIP.																						
Total.	1902	1901	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890	1889	1888	1887	1886	1885	1884	1883	1882	1881	
815	40	65	61	59	82	58	64	73	47	31	57	41	29	40	18	20	14	6	4	2	3	1	1
9	1	2	2	1	2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
8	.....	.....	1	.....	3	2	.....	.....	.....	.....	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	4
10	1	.....	2	.....	.....	.....	3	1	.....	.....	.....	1	.....	.....	.....	.....	1	.....	1	.....	.....	.....	5
2	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	6
3	.....	.....	.....	1	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
6	1	.....	.....	1	.....	.....	.....	.....	1	1	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	8
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	9
5	1	1	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	10
19	.....	1	.....	1	.....	2	5	3	.....	.....	3	1	.....	2	1	.....	.....	.....	.....	.....	.....	.....	11
1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12
82	5	5	6	6	7	7	2	7	6	3	8	5	4	5	.....	2	2	1	.....	.....	1	.....	13
62	4	3	2	3	9	6	3	9	4	4	2	2	1	2	2	2	2	.....	1	1	.....	.....	14
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	15
38	.....	1	2	1	7	2	3	3	3	.....	2	7	2	2	1	1	.....	1	.....	.....	.....	.....	16
11	1	3	.....	.....	.....	.....	.....	.....	2	.....	.....	1	.....	.....	3	.....	1	.....	.....	.....	.....	.....	17
8	.....	1	.....	.....	1	.....	1	1	1	2	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	18
10	.....	2	1	1	4	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	19
2	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	20
5	.....	1	.....	1	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	21
17	.....	.....	1	1	.....	.....	1	2	2	.....	2	.....	3	3	.....	.....	1	.....	.....	.....	1	.....	22
81	1	5	3	7	6	6	8	14	5	5	2	3	1	4	2	3	3	1	1	.....	1	.....	23
70	4	3	6	10	6	4	4	8	8	3	6	2	2	2	.....	1	.....	1	.....	.....	.....	.....	24
18	1	3	4	2	4	2	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	25
43	5	3	4	2	4	3	4	1	3	1	5	2	1	4	.....	1	.....	.....	.....	.....	.....	.....	26
1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	27
11	.....	2	1	.....	1	.....	.....	1	.....	.....	2	.....	1	.....	1	1	.....	.....	1	.....	.....	.....	28
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	29
1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30
4	.....	2	.....	.....	.....	.....	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	31
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	32
28	.....	2	4	1	1	2	6	3	.....	.....	.....	3	1	2	1	2	.....	.....	.....	.....	.....	.....	33
16	.....	4	4	.....	.....	2	.....	1	.....	1	1	.....	.....	1	2	.....	.....	.....	.....	.....	.....	.....	34
8	.....	2	1	2	.....	2	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	35
88	1	7	5	8	8	8	13	7	7	3	8	3	3	3	1	1	1	1	.....	.....	.....	.....	36
2	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	37
6	.....	1	.....	.....	.....	.....	.....	.....	.....	1	1	1	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	38
36	1	3	2	4	6	1	1	1	2	1	6	1	3	2	.....	.....	1	.....	.....	.....	.....	1	39
1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
8	.....	.....	.....	1	5	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	41
6	2	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....	42
19	4	1	2	1	2	1	1	1	.....	1	2	.....	.....	2	.....	1	.....	.....	.....	.....	.....	.....	43
7	1	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	3	1	.....	.....	.....	1	.....	.....	.....	.....	.....	44
1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	45
11	.....	1	.....	.....	.....	2	4	3	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	46
10	.....	1	1	.....	.....	.....	.....	.....	.....	.....	1	2	2	1	.....	.....	1	1	.....	.....	.....	.....	47
7	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1	3	1	.....	.....	.....	.....	.....	1	.....	.....	48
6	2	.....	1	.....	2	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	49
28	4	3	4	3	2	3	.....	1	2	2	2	.....	1	1	.....	.....	.....	.....	.....	.....	.....	.....	50
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	51

TABLE 66.—SUMMARY—PRIVATE AND MUNICIPAL

	STATE OR TERRITORY.	Number of stations.	Cost of construction and equipment.	Gross income.	INCOME FROM SALE OF CURRENT.				Income from all other sources.	EXPENSES.	
					Total.	Arc lighting.	Incandescent lighting.	All other electric service.		Total.	Salaries and wages.
1	United States	3,620	$504,740,352	$85,700,605	[1]$84,186,605	$25,481,045	$44,657,102	$14,048,458	$1,514,000	$68,081,375	$20,646,692
2	Alabama	25	908,895	385,263	374,138	118,999	211,757	43,382	11,125	284,537	87,049
3	Arizona	13	810,341	293,066	288,019	34,220	209,019	44,780	5,047	240,953	82,644
4	Arkansas	42	1,082,505	425,317	413,775	123,418	259,695	30,662	11,542	278,817	90,759
5	California	115	36,547,474	5,066,417	4,946,090	1,000,066	2,305,252	1,640,772	120,327	3,918,975	1,176,741
6	Colorado	48	8,665,826	1,652,505	1,628,953	308,152	901,608	419,193	23,552	1,537,471	482,588
7	Connecticut	38	6,583,477	1,319,549	1,317,512	348,858	764,896	203,758	2,037	981,831	329,763
8	Delaware[2]	10	4,667,770	749,841	742,080	118,925	443,804	179,351	7,761	651,187	121,711
9	Florida	26	974,425	324,770	323,414	60,625	247,851	14,938	1,356	224,637	73,315
10	Georgia	43	1,252,578	357,565	348,753	99,379	212,224	37,150	8,812	254,838	92,173
11	Idaho	19	785,030	192,206	191,126	41,780	143,755	5,591	1,080	141,160	66,719
12	Illinois	346	38,329,275	6,757,015	6,692,248	2,237,413	3,611,938	842,897	64,767	4,961,915	1,603,904
13	Indiana	180	6,706,510	2,105,146	2,038,121	970,378	945,757	121,986	67,025	1,573,908	549,428
14	Indian Territory	10	176,870	94,346	89,122	16,382	72,326	414	5,224	57,521	21,950
15	Iowa	169	8,554,234	1,545,663	1,477,348	347,856	1,041,788	87,704	68,315	1,223,682	406,819
16	Kansas	61	2,023,886	650,833	611,966	215,085	348,318	48,563	38,867	480,482	167,762
17	Kentucky	58	3,670,152	850,086	848,399	301,344	439,534	107,521	1,687	709,234	216,438
18	Louisiana	25	6,056,603	971,631	967,027	395,175	455,296	116,556	4,604	682,939	226,050
19	Maine	52	4,824,850	692,350	668,575	124,668	450,050	93,857	23,775	571,089	202,726
20	Maryland	32	7,157,986	962,207	951,316	332,340	522,458	96,518	10,891	795,663	204,888
21	Massachusetts	114	29,562,267	6,340,944	6,244,882	1,859,484	3,408,629	981,769	96,062	4,708,732	1,588,836
22	Michigan	201	11,559,169	2,613,812	2,516,800	887,667	1,398,328	230,805	97,012	1,948,546	728,952
23	Minnesota	138	9,236,505	1,858,789	1,838,806	467,309	1,148,457	223,040	19,983	1,459,874	433.256
24	Mississippi	43	899,477	366,934	341,546	78,762	240,631	22,153	25,388	277,719	95,300
25	Missouri	123	15,679,872	2,392,149	2,360,150	719,143	1,235,419	405,588	31,999	2,042,422	684,197
26	Montana	27	4,740,807	1,025,971	1,017,805	153,061	544,427	320,317	8,166	660,476	218,202
27	Nebraska	54	3,305,840	601,777	597,304	170,184	372,133	54,987	4,473	431,342	149,190
28	Nevada	5	301,785	44,549	44,549	6,572	37,827	150	.....	39,687	14,776
29	New Hampshire	51	6,447,560	832,322	826,176	200,106	409,279	216,791	6,146	554,967	187,933
30	New Jersey	64	56,432,502	3,421,304	3,356,599	1,280,454	1,519,507	556,638	64,705	3,418,914	821,739
31	New Mexico	11	369,877	135,307	133,747	24,087	103,660	6,000	1,560	102,201	34,740
32	New York	256	112,998,778	16,854,839	16,742,239	4,944,575	7,976,232	3,821,432	112,600	14,706,366	3,904,706
33	North Carolina	38	803,936	250,133	241,903	84,916	141,460	15,527	8,230	192,775	67,996
34	North Dakota	21	416,843	197,689	197,375	42,709	139,816	14,850	314	157,275	47,260
35	Ohio	233	26,381,397	4,431,038	4,347,506	1,816,262	2,057,077	474,167	83,532	3,286,336	1,053,991
36	Oklahoma	10	420,646	187,106	178,331	57,901	108,018	12,412	8,775	119,018	39,979
37	Oregon	39	5,157,651	691,582	638,571	128,006	369,623	140,942	53,011	499,632	167,755
38	Pennsylvania	279	41,579,338	9,486,867	9,311,416	3,300,095	5,021,671	989,650	175,451	7,547,967	2,095,415
39	Rhode Island	7	5,429,796	1,026,407	985,595	393,473	423,300	168,822	40,812	803,161	238,724
40	South Carolina	24	2,442,989	387,010	356,066	82,001	98,972	175,093	30,944	272,729	75,642
41	South Dakota	28	623,504	207,868	204,292	57,351	141,903	5,038	3,576	157,971	58,116
42	Tennessee	54	3,603,088	912,482	911,555	189,324	527,093	195,138	927	587,032	165,041
43	Texas	137	5,510,491	2,074,558	2,049,225	382,603	1,371,078	295,544	25,333	1,477,931	509,181
44	Utah	16	7,521,780	714,353	664,240	92,431	342,995	228,814	50,113	607,769	177,391
45	Vermont	52	2,691,170	485,505	461,898	92,173	280,235	89,490	23,607	333,853	132,645
46	Virginia	37	1,089,347	210,632	210,176	70,834	131,301	8,041	456	171,185	68,249
47	Washington	40	3,537,022	783,651	739,743	163,780	422,494	153,469	43,908	651,495	218,177
48	West Virginia	41	1,123,449	322,015	320,443	114,179	192,987	13,277	1,572	229,558	95,343
49	Wisconsin	152	4,678,316	1,288,020	1,270,669	397,733	780,616	92,320	17,351	957,021	324,308
50	Wyoming	13	467,463	159,216	159,016	28,807	129,608	601	200	111,582	46,125
51	Alaska and Hawaii	4	822,523	336,005	207,600	14,530	169,065	24,005	128,405	262,934	89,154

[1] Includes estimated income of municipal stations from public lighting.
[2] Includes 2 stations in District of Columbia, in order that the operations of individual stations may not be disclosed.

STATIONS, BY STATES AND TERRITORIES: 1902.

EXPENSES—continued.			TOTAL HORSEPOWER.		Output of stations, kilowatt hours.	Electric line construction, miles of mains and feeders.	NUMBER OF LAMPS.		AVERAGE NUMBER OF EMPLOYEES AND TOTAL SALARIES AND WAGES.				
									Salaried officials and clerks.		Wage-earners.		
Cost of supplies, materials, and fuel.	Rents, taxes, insurance, and miscellaneous.	Interest on bonds.	Engines and water wheels.	Dynamos.			Arc.	Incandescent.	Number.	Salaries.	Average number.	Wages.	
$22,915,932	$11,895,206	$12,623,545	1,845,048	1,624,980	2,507,051,115	125,144.14	385,698	18,194,044	6,996	$5,668,580	23,330	$14,983,112	1
112,974	43,036	41,478	7,620	5,996	11,616,707	463.94	2,033	61,373	41	31,637	121	55,412	2
116,789	22,620	18,900	2,540	2,428	3,662,045	119.50	295	36,556	28	30,545	58	52,099	3
129,886	35,532	22,640	8,433	8,074	9,965,997	540.78	1,654	82,234	36	27,354	113	63,405	4
1,366,132	676,549	699,553	134,788	112,354	152,728,042	5,080.16	15,764	1,006,875	351	395,587	1,009	781,154	5
508,023	291,635	255,225	38,268	29,234	60,177,084	1,356.93	4,770	295,605	155	141,885	433	340,703	6
387,224	123,768	141,076	28,389	20,799	26,738,121	2,054.91	6,399	271,805	104	106,807	395	222,956	7
281,976	167,085	80,415	10,123	11,303	17,871,872	473.94	3,144	157,671	45	34,729	163	86,982	8
117,376	17,116	16,830	6,114	6,299	8,066,078	373.25	1,106	61,144	30	18,044	106	55,271	9
120,936	21,929	19,800	12,630	10,215	9,911,243	553.00	1,452	60,139	56	32,467	147	59,706	10
37,651	23,140	13,650	5,454	3,718	5,018,149	211.75	557	33,262	23	19,790	65	46,929	11
1,731,353	868,789	757,869	126,866	134,476	161,543,646	8,347.00	38,215	1,567,665	580	480,947	1,759	1,122,957	12
672,150	220,537	131,793	54,237	51,130	75,585,493	4,508.94	15,325	656,451	243	156,360	698	393,068	13
29,355	6,216	.....	1,475	1,460	1,196,411	130.22	197	13,594	7	5,850	27	16,100	14
524,635	160,489	131,739	39,504	33,359	36,506,425	2,783.36	5,929	420,847	196	117,589	536	289,230	15
210,053	77,420	25,247	13,283	11,524	13,326,518	1,072.08	3,498	128,857	78	44,606	214	123,156	16
237,281	183,135	72,380	21,415	20,123	27,835,614	1,070.50	4,598	142,662	75	60,563	292	155,875	17
218,118	88,608	150,163	13,767	10,431	17,474,261	516.29	4,278	135,593	78	67,099	258	158,951	18
174,527	102,597	91,239	24,889	20,498	21,987,700	1,697.65	2,254	204,632	88	50,396	252	152,330	19
282,523	116,965	191,287	19,740	17,703	22,128,125	6,715.04	5,761	125,087	83	53,444	258	151,444	20
1,530,477	1,309,668	279,751	124,213	121,479	125,813,392	13,448.96	28,790	1,420,963	459	471,250	1,565	1,117,586	21
754,184	260,082	205,328	64,883	59,217	80,564,630	4,720.26	17,712	805,127	313	203,694	942	525,258	22
588,685	208,987	228,946	34,823	28,149	40,258,632	2,036.94	8,543	384,705	175	123,653	474	309,603	23
137,754	30,405	14,260	7,660	6,844	9,825,926	588.00	1,035	85,111	44	29,422	138	65,878	24
732,724	278,395	347,106	45,318	43,030	57,450,731	4,022.82	13,144	593,798	219	185,715	778	498,482	25
205,700	123,684	112,790	31,887	29,564	36,435,766	648.69	1,648	101,868	53	73,308	149	144,994	26
160,929	66,299	54,924	12,308	11,276	12,315,775	1,503.15	2,608	151,162	55	42,801	182	106,389	27
13,720	3,391	7,800	1,720	1,024	1,508,910	26.50	78	8,213	7	5,400	11	9,376	28
151,968	96,126	118,940	28,096	23,829	27,377,793	1,426.75	2,879	170,541	77	46,580	217	141,353	29
953,842	433,646	1,204,687	68,761	61,824	78,739,456	6,160.88	15,685	646,762	258	265,566	816	556,178	30
46,722	14,009	6,730	1,780	1,321	2,637,810	125.50	272	22,507	12	11,320	33	23,420	31
3,927,569	2,662,001	4,212,090	323,413	251,007	701,769,716	13,844.22	59,130	3,705,525	897	814,600	4,524	3,090,106	32
79,605	16,038	29,136	6,566	5,551	8,351,346	448.10	1,178	45,181	45	27,934	96	40,062	33
85,072	19,673	5,270	3,930	2,737	5,850,115	156.00	502	41,916	25	16,470	50	30,790	34
1,268,948	621,767	341,630	103,745	93,580	127,437,383	7,346.12	31,839	934,213	465	263,190	1,301	790,801	35
58,162	10,377	10,500	2,932	2,587	2,629,352	303.00	717	23,849	14	13,430	44	26,549	36
99,334	71,053	161,490	17,798	14,967	17,531,660	1,502.17	2,023	95,045	46	61,340	141	106,415	37
2,353,418	1,330,538	1,768,596	175,510	162,719	241,094,328	15,127.14	47,722	1,783,683	713	535,721	2,467	1,559,694	38
305,918	218,772	39,747	17,600	16,272	23,436,435	3,690.50	5,161	196,188	38	71,494	236	167,230	39
110,452	27,345	59,290	21,205	17,950	18,426,763	325.15	1,366	46,068	40	26,479	120	49,163	40
75,256	18,099	6,500	5,057	3,900	4,256,007	237.00	798	63,248	22	18,068	63	40,048	41
222,752	92,378	106,861	19,003	19,754	24,472,682	1,403.50	3,662	174,291	65	48,987	241	116,054	42
663,035	262,800	42,915	34,887	34,997	48,888,450	1,502.38	5,146	303,591	173	127,747	600	381,434	43
156,722	118,701	154,955	20,460	18,664	32,457,063	566.62	1,469	92,165	69	57,543	171	119,848	44
107,472	53,848	39,888	23,857	15,338	22,374,060	1,746.03	1,584	161,106	89	39,595	153	93,050	45
69,276	22,915	10,745	5,443	5,131	6,879,243	434.37	1,278	37,645	63	22,071	107	46,178	46
250,912	97,578	84,828	22,894	18,337	19,722,262	523.18	2,977	108,443	75	68,365	199	149,812	47
101,657	28,860	3,698	10,820	9,363	11,355,905	514.38	1,898	78,066	44	19,030	134	76,313	48
404,606	132,280	95,827	35,715	30,990	29,966,758	2,601.84	7,416	428,930	131	85,158	434	239,150	49
40,099	18,325	7,033	3,229	2,455	3,883,285	94.75	259	22,062	13	11,950	40	34,175	50
128,218	44,612	950	3,583	2,988	3,430,600	118.90	152	33,877	26	25,387	75	63,767	51

TABLE 67.—CONDENSED STATEMENT: INCOME AND EXPENSES—PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902.

STATE OR TERRITORY.	Number of stations.	Gross income.	INCOME FROM SALE OF CURRENT.				Income from all other sources.	EXPENSES.				
			Total.	Arc lighting.	Incandescent lighting.	All other electric service.		Total.	Salaries and wages.	Cost of supplies, materials, and fuel.	Rents, taxes, insurance, and miscellaneous.	Interest on bonds.
United States...	2,805	$78,735,500	$77,349,749	$22,091,800	$41,297,484	$13,960,465	$1,385,751	$62,835,388	$18,766,970	$20,498,641	$11,456,037	$12,118,740
Alabama	16	340,289	329,164	105,471	180,491	43,202	11,125	250,293	77,089	95,952	41,036	36,216
Arizona	13	293,066	288,019	34,220	209,019	44,780	5,047	240,953	82,644	116,789	22,620	18,900
Arkansas	34	382,278	371,844	104,441	237,041	30,362	10,434	240,064	77,354	110,084	32,506	20,120
California	105	4,937,444	4,824,039	966,083	2,230,396	1,627,560	113,405	3,828,531	1,144,447	1,323,325	669,058	691,701
Colorado	46	1,646,979	1,623,427	307,432	896,802	419,193	23,552	1,532,663	480,968	505,779	290,991	254,925
Connecticut	35	1,273,618	1,271,576	332,947	737,415	201,214	2,037	948,133	319,058	370,239	121,385	137,451
Florida	21	191,637	190,281	26,563	154,156	9,562	1,356	145,431	46,080	76,761	12,480	10,110
Georgia	24	225,795	220,249	45,327	137,772	37,150	5,546	155,470	60,683	68,708	17,429	8,650
Idaho	18	186,554	185,474	40,940	138,943	5,591	1,080	136,780	63,749	36,591	23,140	13,300
Illinois	264	5,578,012	5,514,569	1,320,483	3,351,457	842,629	63,443	4,241,089	1,315,867	1,385,712	800,533	738,977
Indiana	118	1,604,099	1,551,770	716,359	716,341	119,070	52,329	1,215,113	421,937	492,186	192,412	108,578
Indian Territory	10	94,346	89,122	16,382	72,326	414	5,224	57,521	21,950	29,355	6,216	.....
Iowa	131	1,297,589	1,243,807	300,684	857,405	85,718	53,782	1,034,893	343,996	429,205	143,879	117,813
Kansas	50	588,138	550,581	170,455	332,452	47,674	37,557	430,853	148,434	189,669	70,310	22,440
Kentucky	50	787,700	786,175	261,295	418,859	106,021	1,525	662,360	195,179	215,169	179,632	72,380
Louisiana	15	894,240	891,511	376,233	400,735	114,543	2,729	618,906	201,144	188,129	84,063	145,570
Maine	50	678,250	654,475	115,068	445,550	93,857	23,775	563,774	197,962	173,186	101,387	91,239
Maryland	27	928,062	917,371	305,031	515,892	96,448	10,691	764,842	193,446	268,942	114,847	187,607
Massachusetts	97	6,070,643	5,979,960	1,762,998	3,238,969	977,993	90,683	4,445,748	1,501,565	1,424,796	1,272,372	247,015
Michigan	120	1,855,714	1,798,106	501,271	1,073,690	223,145	57,608	1,365,973	510,284	514,885	214,725	126,079
Minnesota	68	1,448,084	1,428,452	360,903	847,179	220,370	19,632	1,124,191	326,351	412,779	186,596	198,465
Mississippi	25	245,788	226,227	46,326	159,407	20,494	19,561	182,835	65,873	88,729	26,253	1,980
Missouri	80	2,121,604	2,098,622	604,283	1,092,239	402,100	22,982	1,829,745	610,210	632,069	263,927	323,539
Montana	26	1,009,763	1,001,597	149,061	532,279	320,257	8,166	648,688	215,098	199,526	122,294	111,770
Nebraska	43	540,859	536,386	149,564	332,276	54,546	4,473	383,419	132,118	136,933	64,068	50,300
Nevada	5	44,549	44,549	6,572	37,827	150	.....	39,687	14,776	13,720	3,391	7,800
New Hampshire	50	829,072	822,926	200,106	406,029	216,791	6,146	551,984	187,333	149,755	96,126	118,720
New Jersey	60	3,378,651	3,313,946	1,269,254	1,488,139	556,553	64,705	3,388,132	812,518	943,239	431,438	1,200,937
New Mexico	11	135,307	133,747	24,067	103,660	6,000	1,560	102,201	34,740	46,722	14,009	6,730
New York	228	16,631,802	16,519,489	4,825,469	7,882,479	3,811,541	112,313	14,519,374	3,837,815	3,842,883	2,643,571	4,195,105
North Carolina	22	154,407	146,177	40,495	90,335	15,347	8,230	119,519	45,322	41,828	12,848	19,521
North Dakota	13	143,205	142,891	25,484	102,557	14,850	314	112,891	32,470	61,404	17,217	1,800
Ohio	145	3,729,339	3,652,778	1,477,236	1,709,405	466,137	76,561	2,716,493	846,455	1,016,815	586,764	266,459
Oklahoma	8	171,179	164,570	54,493	97,665	12,412	6,609	108,645	35,659	53,731	9,255	10,000
Oregon	33	670,262	617,251	124,230	352,079	140,942	53,011	482,479	162,215	91,170	69,604	159,490
Pennsylvania	243	9,057,503	8,885,063	3,035,130	4,862,830	987,103	172,440	7,242,338	1,980,052	2,228,405	1,297,557	1,736,324
Rhode Island	6	1,017,630	976,826	388,339	419,665	168,822	40,804	795,134	236,394	302,577	217,313	38,850
South Carolina	16	338,219	309,059	59,238	74,728	175,093	29,160	226,658	61,085	87,161	24,750	53,662
South Dakota	22	179,114	175,538	45,394	125,106	5,038	3,576	135,371	50,596	62,365	17,170	5,240
Tennessee	35	828,189	828,062	155,216	478,108	194,738	127	519,219	141,202	190,868	89,069	98,080
Texas	130	1,967,568	1,932,235	332,728	1,309,393	290,114	25,333	1,393,823	478,806	621,010	254,992	39,015
Utah	15	711,483	661,370	92,411	340,145	228,814	50,113	605,767	175,831	156,569	118,517	154,850
Vermont	41	433,392	415,348	89,348	241,830	84,170	18,044	298,216	118,125	103,343	47,119	29,629
Virginia	27	154,806	154,350	35,738	111,052	7,560	456	128,307	52,059	51,905	18,593	5,850
Washington	33	635,443	592,363	120,171	323,344	148,848	43,080	506,027	178,190	180,579	81,480	65,778
West Virginia	35	265,276	263,704	62,909	187,518	13,277	1,572	198,045	77,461	88,002	26,244	1,338
Wisconsin	124	1,166,533	1,150,206	363,541	694,345	92,320	16,327	864,353	294,563	363,497	121,389	84,904
Wyoming	13	159,216	159,016	28,807	129,608	601	200	111,582	46,125	40,099	18,325	7,033
All other states[1]	4	722,809	715,481	115,584	420,546	179,351	7,328	625,925	113,692	270,596	165,137	76,500
Alaska and Hawaii	4	336,005	207,600	14,530	169,065	24,005	128,405	262,934	89,154	128,218	44,612	950

[1] Includes states having less than 3 stations, in order that the operations of individual stations may not be disclosed. These stations are distributed as follows: Delaware, 2; District of Columbia, 2.

TABLE 68.—ANALYSIS OF INCOME—PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902.

STATE OR TERRITORY.	Number of stations.	Gross income.	INCOME FROM—											
			Arc lighting.			Incandescent lighting.			Motor service.	Electric railway service.	Electric heating.	Charging automobiles.	All other electric service.	All other sources.
			Total.	Commercial or other private.	Public.	Total.	Commercial or other private.	Public.						
United States...	2,805	$78,735,500	$22,091,800	$8,220,154	$13,871,646	$41,297,484	$39,039,557	$2,257,927	$9,839,677	$2,301,343	$39,155	$29,959	$1,750,331	$1,385,751
Alabama	16	340,289	105,471	39,186	66,285	180,491	176,933	3,558	29,995	13,207	.....	.....	.....	11,125
Arizona	13	293,066	34,220	19,268	14,952	209,019	206,120	2,899	44,780	.....	.....	.....	.....	5,047
Arkansas	34	382,278	104,441	76,963	27,478	237,041	226,986	10,055	22,914	7,448	.....	.....	.....	10,434
California	105	4,937,444	966,083	509,375	456,708	2,230,396	2,172,206	58,190	1,217,379	181,494	75	1,112	227,500	113,405
Colorado	46	1,646,979	307,432	112,036	195,396	896,802	867,933	28,869	343,559	8,920	.....	.....	66,714	23,552
Connecticut	35	1,273,613	332,947	72,780	260,167	737,415	693,656	43,759	153,232	12,152	100	500	35,230	2,037
Florida	21	191,637	26,563	9,175	17,388	154,156	144,360	9,796	2,002	.....	.....	.....	7,560	1,356
Georgia	24	225,795	45,327	5,214	40,113	137,772	127,925	9,847	35,350	1,800	.....	.....	.....	5,546
Idaho	18	186,554	40,940	24,616	16,324	138,943	137,908	1,035	5,591	.....	.....	.....	.....	1,080
Illinois	264	5,578,012	1,320,483	704,352	616,131	3,351,457	3,196,797	154,660	763,496	64,360	.....	560	14,213	63,443
Indiana	118	1,604,099	716,359	218,186	498,173	716,341	686,259	30,082	117,780	733	25	412	120	52,329
Indian Territory	10	94,346	16,382	9,668	6,714	72,326	70,325	2,001	414	.....	.....	.....	.....	5,224
Iowa	131	1,297,589	300,684	107,535	193,149	857,405	761,205	96,200	76,194	7,465	60	.....	1,999	53,782
Kansas	50	588,138	170,455	83,633	86,822	332,452	321,151	11,301	47,669	.....	.....	5	.....	37,557
Kentucky	50	787,700	261,295	46,213	215,082	418,859	402,917	15,942	90,901	15,000	120	.....	.....	1,525
Louisiana	15	894,240	376,233	157,457	218,776	400,735	379,515	21,220	114,543	.....	.....	.....	.....	2,729
Maine	50	678,250	115,068	34,874	80,194	445,550	403,857	41,693	92,032	1,137	56	.....	632	23,775
Maryland	27	928,062	305,031	119,894	185,137	515,892	474,017	41,875	91,367	5,081	.....	.....	.....	10,691
Massachusetts	97	6,070,643	1,762,998	504,633	1,258,365	3,238,969	2,904,362	334,607	741,103	226,547	.....	.....	10,343	90,683
Michigan	120	1,855,714	501,271	275,791	225,480	1,073,690	1,048,938	24,752	166,221	55,830	334	237	523	57,608
Minnesota	68	1,448,084	360,903	152,546	208,357	847,179	812,450	34,729	188,862	7,094	24,289	125	.....	19,632
Mississippi	25	245,788	46,326	5,593	40,733	159,407	149,413	9,994	17,082	1,618	.....	.....	1,794	19,561
Missouri	80	2,121,604	604,283	487,379	116,904	1,092,239	1,002,846	89,393	400,129	1,971	.....	.....	.....	22,982
Montana	26	1,009,763	149,061	85,011	64,050	532,279	528,634	3,645	32,821	30,100	.....	.....	257,336	8,166
Nebraska	43	540,859	149,564	66,604	82,960	332,276	315,592	16,684	54,371	.....	.....	.....	175	4,473
Nevada	5	44,549	6,572	2,240	4,332	37,827	37,659	168	150	.....	.....	.....	.....	.....
New Hampshire	50	829,072	200,106	46,967	153,139	406,029	351,123	54,906	82,257	71,586	126	.....	62,822	6,146
New Jersey	60	3,378,651	1,269,254	381,324	887,930	1,488,139	1,296,266	191,873	258,035	297,361	.....	389	768	64,705
New Mexico	11	135,307	24,087	14,933	9,154	103,660	101,790	1,870	6,000	.....	.....	.....	.....	1,560
New York	228	16,631,802	4,825,469	1,813,659	3,011,810	7,882,479	7,460,470	422,009	2,394,655	389,829	6,087	12,685	1,008,285	112,313
North Carolina	22	154,407	40,495	4,842	35,653	90,335	79,393	10,942	15,347	.....	.....	.....	.....	8,230
North Dakota	13	143,205	25,484	9,904	15,580	102,557	99,234	3,323	8,850	.....	6,000	.....	.....	314
Ohio	145	3,729,339	1,477,236	478,390	998,846	1,709,405	1,640,723	68,682	402,376	63,761	.....	.....	.....	76,561
Oklahoma	8	171,179	54,493	25,554	28,939	97,665	97,380	285	12,412	.....	.....	.....	.....	6,609
Oregon	33	670,262	124,230	53,500	70,730	352,079	335,289	16,790	89,942	51,000	.....	.....	.....	53,011
Pennsylvania	243	9,057,503	3,035,130	764,799	2,270,331	4,862,830	4,706,113	156,717	689,860	324,749	1,182	120	21,192	172,440
Rhode Island	6	1,017,630	388,339	71,613	316,726	419,665	365,211	54,454	120,935	47,887	.....	.....	.....	40,804
South Carolina	16	338,219	59,238	23,752	35,486	74,728	72,224	2,504	169,353	5,644	96	.....	.....	29,160
South Dakota	22	179,114	45,394	25,739	19,655	125,106	119,615	5,491	5,038	.....	.....	.....	.....	3,576
Tennessee	35	828,189	155,216	46,876	108,340	478,108	462,664	15,444	134,023	60,715	.....	.....	.....	127
Texas	130	1,957,568	332,728	173,701	159,027	1,309,393	1,270,017	39,376	198,429	91,220	427	38	.....	25,333
Utah	15	711,483	92,411	51,914	40,497	340,145	331,500	8,645	156,331	48,015	78	.....	24,390	50,113
Vermont	41	433,392	89,348	19,396	69,952	241,830	227,040	14,790	63,398	17,442	100	.....	3,230	18,044
Virginia	27	154,806	35,738	10,968	24,770	111,052	103,461	7,591	7,560	.....	.....	.....	.....	456
Washington	33	635,443	120,171	80,157	40,014	328,344	313,553	9,791	62,245	86,588	.....	3	12	43,080
West Virginia	35	265,276	62,909	20,036	42,873	187,518	179,190	8,328	7,509	2,940	.....	.....	2,828	1,572
Wisconsin	124	1,166,533	363,541	127,889	235,652	694,345	653,666	40,679	75,992	14,081	.....	123	2,124	16,327
Wyoming	13	159,216	28,807	15,569	13,238	129,608	125,764	3,844	60	.....	.....	.....	541	200
All other states[1]	4	722,809	115,584	28,450	87,134	420,546	397,907	22,639	79,133	86,568	.....	13,650	.....	7,328
Alaska and Hawaii	4	836,005	14,530	12,070	2,460	169,065	131,424	37,641	24,005	.....	.....	.....	.....	128,405

[1] Includes states having less than 3 stations, in order that the operations of individual stations may not be disclosed. These stations are distributed as follows: Delaware, 2; District of Columbia, 2.

TABLE 69.—CHARACTER OF OWNERSHIP, SERVICE, CAPITALIZATION, AND COST OF

	STATE OR TERRITORY.	Number of stations.	NUMBER OF STATIONS BY CHARACTER OF OWNERSHIP.					NUMBER OF STATIONS BY CHARACTER OF SERVICE.							STOCKS AND BONDS ISSUED.	CAPITAL STOCK.		
			When installed.			In 1902.		Arc lighting.		Incandescent lighting.		Motor power.				Total.		
			Individual.	Corporation.	Municipal.	Individual.	Corporation.	Commercial or other private.	Public.	Commercial or other private.	Public.	Stationary.	Electric railway.	All other.	Total par value.	Authorized.	Issued.	Dividends.
1	United States.	2,805	964	1,828	13	756	2,049	1,667	1,810	2,752	1,889	975	157	152	$627,515,875	$435,178,372	$372,951,952	$6,189,837
2	Alabama	16	2	13	1	2	14	14	15	15	8	6	2	.....	1,597,600	829,500	796,300	1,500
3	Arizona	13	5	8	.....	2	11	8	5	13	2	6	.....	1	1,177,000	822,000	822,000	2,800
4	Arkansas	34	17	17	.....	14	20	20	19	34	15	7	1	.....	979,275	577,100	564,475	8,600
5	California	105	23	82	.....	16	89	60	45	101	48	64	7	.....	51,058,045	58,098,700	36,897,745	664,721
6	Colorado	46	4	42	.....	3	43	36	34	44	38	17	2	2	15,341,950	10,956,200	9,760,450	55,226
7	Connecticut	35	2	33	.....	1	34	17	21	34	26	10	2	4	7,239,475	6,645,000	4,154,700	197,840
8	Florida	21	11	10	.....	10	11	12	14	21	13	2	.....	2	420,500	243,500	221,500	.....
9	Georgia	24	5	19	.....	4	20	14	20	24	21	4	1	.....	810,400	779,400	645,400	5,040
10	Idaho	18	7	11	.....	5	13	12	11	18	7	5	.....	1	1,016,200	767,500	758,200	23,325
11	Illinois	264	137	127	.....	116	148	144	182	263	183	80	8	.....	35,889,835	26,003,050	20,789,535	579,714
12	Indiana	118	51	66	1	37	81	74	85	116	71	45	1	41	5,910,098	3,771,650	3,368,015	66,649
13	Indian Territory	10	6	4	.....	3	7	9	9	10	7	4	.....	.....	125,500	156,500	125,500	.....
14	Iowa	131	53	77	1	41	90	82	90	131	105	30	2	.....	7,405,650	6,255,300	5,074,750	37,418
15	Kansas	50	24	26	.....	18	32	40	34	50	33	23	.....	.....	1,497,350	1,350,750	1,048,850	22,336
16	Kentucky	50	17	33	.....	12	38	18	35	50	22	13	.....	1	3,912,100	2,521,000	2,321,600	8,818
17	Louisiana	15	2	13	.....	1	14	7	12	15	11	7	.....	.....	6,782,200	3,887,300	3,836,200	101,800
18	Maine	50	12	38	.....	8	42	25	25	50	42	19	1	13	4,510,410	2,823,100	2,243,910	41,890
19	Maryland	27	6	21	.....	2	25	11	11	27	24	5	1	1	8,919,634	5,616,874	4,813,134	118,818
20	Massachusetts	97	10	87	.....	10	87	67	76	93	80	48	18	3	21,412,506	17,277,166	16,971,000	1,225,129
21	Michigan	120	65	55	.....	49	71	89	93	117	76	32	6	23	8,584,570	6,566,000	5,841,570	127,833
22	Minnesota	68	43	24	1	33	35	46	59	68	48	15	2	.....	8,109,500	5,930,300	3,952,500	78,137
23	Mississippi	25	10	15	.....	7	18	15	13	25	17	13	1	1	429,100	560,900	345,100	4,982
24	Missouri	80	34	46	.....	28	52	50	45	79	51	41	1	35	16,245,020	10,279,120	9,816,720	55,700
25	Montana	26	9	17	.....	4	22	15	13	21	8	10	3	6	8,358,700	6,597,000	6,351,700	68,816
26	Nebraska	43	19	24	.....	20	23	30	29	43	33	10	.....	.....	3,197,450	2,472,450	2,150,450	3,992
27	Nevada	5	1	4	.....	2	3	3	3	5	1	1	.....	.....	288,000	158,000	158,000	.....
28	New Hampshire	50	11	39	.....	7	43	15	21	50	43	18	4	9	6,617,400	7,720,500	4,130,900	141,353
29	New Jersey	60	7	53	.....	5	55	34	41	60	51	22	9	.....	58,844,336	32,452,400	31,174,836	27,080
30	New Mexico	11	4	7	.....	5	6	7	7	11	4	1	.....	.....	445,900	340,000	316,900	8,000
31	New York	228	63	164	1	42	186	121	141	224	167	91	16	.....	190,300,149	112,170,500	104,245,475	682,245
32	North Carolina	22	7	15	.....	7	15	10	15	19	12	5	.....	.....	882,600	717,100	554,200	3,200
33	North Dakota	13	6	7	.....	6	7	8	10	13	7	3	.....	1	91,000	96,000	61,000	920
34	Ohio	145	48	96	1	40	105	106	113	142	92	56	8	.....	24,839,632	21,065,566	19,299,799	575,123
35	Oklahoma	8	3	5	.....	2	6	7	8	8	3	3	.....	.....	695,000	605,000	495,000	6,000
36	Oregon	33	18	15	.....	15	18	23	18	33	26	6	1	.....	7,037,300	4,887,500	4,370,800	16,530
37	Pennsylvania	243	28	214	1	22	221	152	160	236	166	91	33	.....	78,636,619	41,959,533	41,147,450	679,808
38	Rhode Island	6	1	5	.....	.....	6	4	5	6	5	3	2	.....	3,917,500	6,332,500	3,132,500	178,297
39	South Carolina	16	5	11	.....	2	14	10	13	15	13	5	1	.....	2,128,150	1,677,000	1,193,150	16,805
40	South Dakota	22	9	13	.....	8	14	15	15	21	16	5	.....	.....	875,250	784,500	747,750	14,495
41	Tennessee	35	12	23	.....	14	21	16	21	34	22	8	4	.....	3,121,950	1,483,600	1,262,150	9,067
42	Texas	130	56	72	2	46	84	68	48	130	74	68	7	.....	4,785,600	3,782,700	3,229,100	93,060
43	Utah	15	1	14	.....	1	14	5	4	13	12	7	1	4	8,394,980	5,221,000	4,440,980	32,720
44	Vermont	41	14	27	.....	10	31	14	17	40	36	13	4	3	1,862,920	2,015,000	1,329,920	30,117
45	Virginia	27	4	21	2	6	21	12	14	26	17	9	.....	.....	804,800	833,000	652,300	4,190
46	Washington	33	15	16	2	10	23	20	17	33	23	7	3	.....	3,153,000	1,940,333	1,780,333	26,648
47	West Virginia	35	9	26	.....	6	29	15	25	33	22	6	1	.....	626,950	1,155,000	604,650	27,932
48	Wisconsin	124	67	57	.....	53	71	75	87	121	78	27	2	.....	4,017,405	2,384,280	2,270,755	50,813
49	Wyoming	13	1	12	.....	1	12	9	10	13	6	1	.....	1	450,766	335,000	314,100	8,250
50	All other states[1]	4	.....	4	.....	.....	4	3	2	4	4	3	2	.....	3,768,600	3,275,000	2,368,600	56,100
51	Alaska and Hawaii.	4	1	3	.....	.....	4	2	2	4	3	3	.....	.....	795,142	1,317,142	767,142	55,700

[1] Includes states having less than 3 stations, in order that the operations of individual stations may not be disclosed. These stations are distributed as follows: Delaware, 2; District of Columbia, 2.

CONSTRUCTION AND EQUIPMENT—PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902.

CAPITAL STOCK—continued.						BONDS.			COST OF CONSTRUCTION AND EQUIPMENT—		
Common.			Preferred.								
Authorized.	Issued.	Dividends.	Authorized.	Issued.	Dividends.	Authorized.	Outstanding.	Interest.	To date.	During the year.	
$407,807,984	$349,080,281	$5,560,341	$27,370,438	$23,871,671	$629,496	$308,117,894	$254,563,923	$12,118,740	$482,719,879	$40,050,613	1
829,500	796,300	1,500	.....	.....	.....	877,500	801,300	36,216	798,605	92,410	2
822,000	822,000	2,800	.....	.....	.....	355,000	355,000	18,900	810,341	284,896	3
577,100	564,475	8,600	.....	.....	.....	414,800	414,800	20,120	972,385	109,913	4
54,098,700	34,897,745	564,721	4,000,000	2,000,000	100,000	26,837,500	14,160,300	691,701	36,131,996	5,210,395	5
10,956,200	9,760,450	55,226	.....	.....	.....	5,961,500	5,581,500	254,925	8,650,886	983,658	6
6,635,000	4,144,700	197,840	10,000	10,000	.....	3,352,500	3,084,775	137,451	6,448,145	407,473	7
243,500	221,500	.....	.....	.....	.....	207,500	199,000	10,110	697,004	64,921	8
767,400	633,400	5,040	12,000	12,000	.....	575,000	165,000	8,650	901,376	40,607	9
767,500	758,200	23,325	.....	.....	.....	288,000	258,000	13,300	778,100	19,760	10
25,962,050	20,757,585	579,504	41,000	32,000	210	15,936,100	15,100,300	738,977	34,601,709	3,074,117	11
3,704,983	3,334,692	66,649	66,667	33,333	.....	3,150,749	2,542,083	108,578	5,198,521	461,426	12
156,500	125,500	.....	.....	.....	.....	.....	.....	.....	176,870	20,699	13
5,805,300	4,745,600	37,418	450,000	329,150	.....	3,022,000	2,330,900	117,813	7,863,126	1,349,958	14
1,350,750	1,048,850	22,336	.....	.....	.....	573,500	448,500	22,440	1,827,170	186,175	15
2,516,000	2,316,600	8,818	5,000	5,000	.....	2,118,500	1,590,500	72,380	3,428,466	86,297	16
1,887,300	1,836,200	1,800	2,000,000	2,000,000	100,000	2,946,000	2,946,000	145,570	5,849,003	149,705	17
2,523,100	2,015,960	31,550	300,000	227,950	10,340	2,792,000	2,266,500	91,239	4,783,150	555,350	18
4,556,874	4,113,134	83,818	1,060,000	700,000	35,000	5,440,000	4,106,500	187,607	7,037,647	202,991	19
17,182,166	16,876,000	1,225,129	95,000	95,000	.....	4,453,506	4,441,506	247,015	28,335,006	8,343,437	20
6,056,000	5,332,820	123,921	510,000	508,750	3,912	2,956,000	2,743,000	126,079	8,569,481	581,878	21
5,180,300	3,202,500	33,137	750,000	750,000	45,000	5,169,000	4,157,000	198,465	8,080,708	712,044	22
560,900	345,100	4,962	.....	.....	.....	126,000	84,000	1,980	595,518	56,016	23
8,098,095	7,685,695	50,700	2,181,025	2,131,025	5,000	6,898,125	6,428,300	323,539	14,834,273	808,485	24
6,597,000	6,351,700	68,816	.....	.....	.....	6,058,000	2,007,000	111,770	4,708,807	784,826	25
1,972,450	1,847,450	3,992	500,000	303,000	.....	1,067,000	1,047,000	50,300	3,151,856	169,247	26
158,000	158,000	.....	.....	.....	.....	130,000	130,000	7,800	301,785	125,260	27
7,605,500	4,015,900	140,453	115,000	115,000	900	3,615,000	2,486,500	118,720	6,437,760	354,067	28
32,442,400	31,164,836	27,080	10,000	10,000	.....	31,538,000	27,669,500	1,200,937	56,239,037	1,135,776	29
340,000	316,900	8,000	.....	.....	.....	129,000	129,000	6,730	369,877	16,726	30
102,798,500	95,330,975	484,045	9,377,000	8,914,500	198,200	101,549,374	86,054,674	4,195,105	112,185,829	4,955,859	31
662,100	499,200	750	55,000	55,000	2,450	367,100	328,400	19,521	575,059	35,579	32
96,000	61,000	920	.....	.....	.....	30,000	30,000	1,800	313,388	37,810	33
19,640,900	18,008,466	514,623	1,424,666	1,291,333	60,500	7,186,000	5,539,833	266,459	24,392,342	1,143,939	34
605,000	495,000	6,000	.....	.....	.....	300,000	200,000	10,000	390,308	84,520	35
3,637,500	3,120,800	16,530	1,250,000	1,250,000	.....	2,686,500	2,666,500	159,490	5,106,613	350,879	36
41,638,583	40,851,200	663,395	320,950	296,250	16,413	40,852,767	37,489,169	1,736,324	40,433,074	3,057,799	37
6,125,000	2,925,000	163,847	207,500	207,500	14,450	1,785,000	785,000	38,850	5,405,877	877,384	38
1,527,000	1,043,150	3,805	150,000	150,000	13,000	952,500	935,000	53,662	2,312,836	221,065	39
734,500	722,500	12,980	50,000	25,250	1,515	180,000	127,500	5,240	537,521	106,675	40
1,481,550	1,260,100	8,950	2,050	2,050	117	1,869,000	1,859,800	98,080	3,240,716	631,885	41
3,670,700	3,117,100	93,060	112,000	112,000	.....	1,908,500	1,556,500	89,015	5,294,470	746,651	42
3,221,000	2,440,980	12,720	2,000,000	2,000,000	20,000	4,500,000	3,954,000	154,850	7,512,281	292,521	43
2,015,000	1,329,920	30,117	.....	.....	.....	885,000	533,000	29,629	2,338,721	109,369	44
826,000	645,300	3,630	7,000	7,000	560	889,500	152,500	5,850	823,429	28,568	45
1,940,333	1,780,333	26,648	.....	.....	.....	1,529,667	1,372,667	65,778	3,003,142	376,106	46
1,155,000	604,650	27,932	.....	.....	.....	22,300	22,300	1,338	968,983	98,291	47
2,325,700	2,222,175	48,884	58,580	48,580	1,929	1,950,240	1,746,650	84,904	4,253,016	236,215	48
335,000	314,100	8,250	.....	.....	.....	136,666	136,666	7,033	467,463	42,940	49
3,025,000	2,118,600	56,100	250,000	250,000	.....	1,550,000	1,400,000	76,500	4,584,208	288,525	50
1,310,000	760,000	55,700	7,142	7,142	.....	28,000	28,000	950	822,523	53,434	51

TABLE 70.—ANALYSIS OF SUPPLIES, MATERIALS, AND FUEL—

	STATE OR TERRITORY.	Number of stations.	Aggregate cost.	METERS.		MOTORS.		TRANSFORMERS.		INCANDESCENT LAMPS.		INCANDESCENT LAMP FITTINGS, SOCKETS, ETC.	CARBONS FOR ARC LAMPS.		GLOBES FOR ARC LAMPS.	
				Number.	Cost.	Number.	Cost.	Number.	Cost.	Number.	Cost.	Cost.	Number.	Cost.	Number.	Cost.
1	United States...	2,805	$20,493,641	25,739	$390,569	572	$29,202	7,843	$326,407	8,399,571	$1,426,224	$154,517	82,156,930	$900,788	428,979	$150,509
2	Alabama	16	95,952	33	572	19	490	13	898	30,955	5,273	2,546	256,700	3,437	1,642	1,180
3	Arizona	13	116,789	22	350	.....	.....	2	228	15,529	2,856	642	51,630	869	325	278
4	Arkansas	34	110,084	30	377	.....	.....	107	3,422	89,203	7,234	832	80,450	1,528	1,213	626
5	California	105	1,823,325	803	18,909	13	203	293	15,295	236,945	38,690	5,537	2,833,907	35,747	19,323	7,437
6	Colorado	46	505,779	363	5,039	3	275	37	5,201	134,059	21,241	1,636	2,024,842	21,507	6,472	3,168
7	Connecticut	35	370,239	425	8,143	10	500	133	6,387	174,387	29,086	1,050	898,740	14,959	2,555	1,225
8	Florida	21	76,761	10	236	.....	.....	37	1,198	14,770	3,157	258	52,582	1,148	1,120	780
9	Georgia	24	68,708	49	1,204	.....	.....	42	2,087	25,940	4,359	1,989	217,940	2,455	861	386
10	Idaho	18	86,591	5	80	.....	.....	25	2,489	3,270	655	880	97,024	1,451	1,113	248
11	Illinois	264	1,385,712	883	12,761	18	1,038	489	15,535	884,737	143,592	12,934	4,433,256	55,635	23,184	8,699
12	Indiana	118	492,186	839	11,920	27	1,909	439	15,753	229,455	37,460	7,470	2,616,938	28,777	11,850	4,098
13	Indian Territory	10	29,355	.....	.....	.....	.....	22	868	12,800	2,080	152	19,550	513	301	86
14	Iowa	131	429,205	436	6,203	183	5,351	205	6,924	113,519	21,049	3,487	793,167	11,004	7,965	2,163
15	Kansas	50	189,669	434	7,524	15	1,425	108	4,948	70,841	11,858	8,337	408,277	6,563	2,964	1,184
16	Kentucky	50	215,169	233	3,200	.....	.....	212	6,805	98,782	15,641	1,137	1,494,915	13,630	4,339	1,467
17	Louisiana	15	188,129	295	3,063	.....	.....	40	2,133	89,466	17,699	175	248,476	15,350	4,502	2,253
18	Maine	50	173,186	90	1,953	.....	.....	59	2,800	97,935	16,245	1,787	274,422	4,179	7,112	1,602
19	Maryland	27	268,942	113	1,365	1	17	62	2,081	27,396	5,054	3,156	1,622,160	16,608	3,496	2,025
20	Massachusetts	97	1,424,796	1,928	20,486	16	972	358	27,852	637,226	115,277	6,779	5,783,329	62,095	26,909	9,203
21	Michigan	120	514,885	193	2,399	5	208	107	4,079	255,540	44,464	11,893	1,255,782	15,401	11,374	3,609
22	Minnesota	68	412,779	125	1,831	13	240	52	2,721	106,716	18,098	2,906	460,328	9,169	4,008	1,874
23	Mississippi	25	88,729	2	24	.....	.....	43	1,306	32,610	5,638	1,107	180,256	2,607	1,519	485
24	Missouri	80	632,069	724	11,303	46	5,563	339	17,039	176,738	39,524	3,465	908,385	14,573	15,240	4,543
25	Montana	26	199,526	86	978	.....	.....	19	1,360	69,329	11,975	845	526,305	7,201	1,752	1,160
26	Nebraska	43	136,933	109	1,871	2	545	47	2,182	39,042	6,840	681	157,859	3,113	1,261	932
27	Nevada	5	13,720	1	20	.....	.....	6	390	5,600	590	50	34,000	444	132	121
28	New Hampshire	50	149,755	241	3,656	.....	.....	165	8,446	36,469	7,753	1,437	1,054,089	9,624	4,393	1,431
29	New Jersey	60	943,239	1,272	10,315	7	392	647	24,439	422,643	66,636	1,246	5,629,560	47,804	27,147	8,341
30	New Mexico	11	46,722	58	689	30	350	4	600	11,850	2,176	2,798	21,500	490	192	165
31	New York	228	3,842,883	8,268	122,560	5	1,081	967	38,303	2,249,754	363,566	21,334	17,674,164	165,940	90,940	25,785
32	North Carolina	22	41,828	11	154	.....	.....	9	402	13,385	2,415	125	101,928	1,674	678	216
33	North Dakota	13	61,404	62	1,125	12	750	24	400	11,550	2,270	545	23,550	498	277	139
34	Ohio	145	1,016,815	1,885	26,424	1	140	611	22,081	340,912	59,414	8,195	5,988,070	59,041	28,049	8,630
35	Oklahoma	8	53,731	.....	.....	.....	.....	19	583	11,900	2,481	467	70,800	1,713	612	233
36	Oregon	33	91,170	107	1,120	.....	.....	135	1,451	26,475	4,785	1,227	947,946	10,171	1,184	752
37	Pennsylvania	243	2,228,405	2,570	57,385	79	2,157	726	26,614	785,828	139,812	19,542	15,238,687	158,630	55,016	20,754
38	Rhode Island	6	302,577	494	6,723	20	4,300	188	8,564	183,133	38,765	.....	2,218,100	17,508	9,421	2,932
39	South Carolina	16	87,161	20	897	.....	.....	42	3,106	10,600	1,877	348	87,106	1,397	896	198
40	South Dakota	22	62,365	19	260	.....	.....	20	332	18,561	3,353	383	54,733	1,126	945	335
41	Tennessee	35	190,868	82	872	.....	.....	33	1,423	58,961	10,077	527	1,099,300	11,210	4,192	2,399
42	Texas	130	621,010	321	4,603	47	1,296	462	11,663	105,390	18,448	2,093	647,963	13,304	16,873	3,456
43	Utah	15	156,569	821	12,302	.....	.....	62	8,640	48,321	9,191	335	409,941	4,963	1,740	938
44	Vermont	41	103,343	216	3,669	.....	.....	62	1,778	48,931	8,795	559	249,813	4,759	1,561	710
45	Virginia	27	51,805	1	14	.....	.....	17	670	7,270	1,316	584	162,597	1,914	494	277
46	Washington	33	180,579	302	4,447	.....	.....	32	1,612	26,971	5,347	4,855	160,480	7,257	1,128	689
47	West Virginia	35	88,002	186	2,933	.....	.....	133	6,422	23,357	4,311	346	264,541	3,901	1,412	542
48	Wisconsin	124	363,497	128	2,209	.....	.....	111	3,666	148,291	25,452	5,058	1,294,384	17,056	5,888	2,256
49	Wyoming	13	40,099	7	95	.....	.....	3	203	6,579	1,182	610	12,608	1,148	159	137
50	All other states[1]	4	270,596	437	6,356	.....	.....	75	3,078	129,650	21,167	222	1,014,000	9,702	13,300	8,362
51	Alaska and Hawaii	4	128,218	10	174	3	637	11	819	6,945	1,520	245	8,100	126	60	28

[1] Includes states having less than 3 stations, in order that the operations of individual stations may not be disclosed. These stations are distributed as follows: Delaware, 2; District of Columbia, 2.

PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902.

ARC LAMP REPAIRS.	POLES OR OTHER SUPPORTS.	WIRE AND CABLE.	MILL SUPPLIES (OIL, WASTE, ETC.).	ALL OTHER MATERIALS.	POWER PURCHASED.	Freight paid, not included in other items.	FUEL.						
							Total cost.	Coal.		Crude petroleum.	Natural gas.	Artificial gas.	All other fuel.
Cost.	Cost.	Cost.	Cost.	Cost.	Cost.			Number of tons.	Cost.	Cost.	Cost.	Cost.	Cost.	
$212,231	$319,617	$1,081,380	$617,911	$1,747,896	$2,007,193	$939,512	$10,189,685	4,249,137	$8,749,394	$700,136	$220,460	$20,135	$499,560	1
694	512	4,249	3,420	4,987	.....	17,312	50,382	27,004	46,478	.....	.....	.....	3,904	2
414	1,380	2,708	3,825	2,810	10,844	3,120	86,465	3,312	24,646	50,600	.....	.....	11,219	3
382	2,326	5,242	4,698	5,160	23,833	1,411	53,013	23,314	41,716	.....	.....	.....	11,297	4
12,490	25,163	38,986	21,361	71,798	486,125	1,417	544,167	5,752	28,365	502,153	1,667	2,437	9,545	5
4,216	6,418	13,246	15,327	25,215	76,813	81,256	225,221	163,637	224,231	.....	.....	.....	990	6
4,573	5,105	16,451	8,448	66,012	37,659	3,990	166,651	41,299	164,007	.....	.....	519	2,125	7
169	866	873	3,174	1,699	.....	284	62,919	6,378	29,255	4,891	.....	.....	28,773	8
819	1,964	2,936	3,011	4,921	.....	8,370	34,207	6,636	10,570	.....	.....	.....	23,637	9
418	1,380	1,065	1,382	782	10,015	840	14,906	548	3,353	.....	.....	.....	11,553	10
20,895	10,758	30,295	46,552	158,412	31,154	84,167	753,285	546,981	747,255	574	3,473	.....	1,983	11
5,323	4,546	18,386	18,150	30,152	17,332	34,927	255,983	140,656	204,900	1,200	45,414	821	3,648	12
45	445	1,730	1,503	848	.....	.....	21,085	8,412	18,005	.....	.....	.....	3,080	13
3,013	6,493	10,572	16,888	27,800	16,689	8,854	282,715	170,373	278,737	.....	.....	100	3,878	14
1,517	1,060	14,101	7,537	17,115	9,227	26,920	70,333	41,767	68,433	.....	1,700	.....	200	15
2,041	1,420	6,323	8,888	9,088	420	10,494	134,615	89,026	134,615	.....	.....	.....	.....	16
1,968	3,054	7,963	6,415	16,863	433	10,639	100,121	17,969	80,753	15,866	.....	.....	3,502	17
5,514	8,197	7,293	6,516	10,123	26,830	2,215	77,932	18,153	75,100	.....	.....	.....	2,832	18
6,477	7,290	8,494	5,712	28,734	2,100	11,989	167,840	69,745	166,410	.....	.....	.....	1,430	19
15,646	21,274	84,554	37,962	64,415	99,722	5,710	852,899	203,456	808,361	88	.....	.....	44,450	20
4,360	13,370	9,519	14,808	20,912	69,216	38,111	262,536	108,322	235,932	.....	.....	.....	26,604	21
2,594	2,514	6,926	9,901	14,951	87,110	27,380	224,564	55,241	175,463	.....	.....	6,692	42,409	22
708	744	8,637	4,286	4,576	565	4,559	53,487	17,801	40,475	.....	.....	.....	13,012	23
5,809	5,630	25,186	19,138	107,237	9,907	8,085	355,067	186,230	345,403	85	.....	25	9,554	24
2,180	2,173	1,410	2,778	9,105	61,269	5,115	91,977	27,153	89,044	.....	.....	.....	2,933	25
1,226	1,872	1,758	4,368	3,446	6,943	33,622	67,534	39,514	66,975	.....	.....	.....	559	26
100	410	670	170	945	4,040	3,510	2,260	660	1,060	.....	.....	.....	1,200	27
3,034	4,032	7,062	3,401	3,322	13,643	2,287	80,627	16,723	75,553	.....	.....	.....	5,074	28
14,216	18,031	23,704	57,730	115,509	53,426	5,346	496,104	167,930	482,291	.....	.....	1,991	11,822	29
311	595	3,807	1,407	1,988	6,720	267	24,359	9,127	21,671	.....	.....	.....	2,688	30
31,064	27,483	450,067	86,932	526,963	428,133	115,769	1,437,903	585,211	1,428,056	.....	4,762	1,233	3,852	31
972	876	311	1,780	2,368	2,889	5,163	22,483	4,916	13,284	.....	.....	.....	9,199	32
157	779	712	1,188	2,495	.....	2,414	47,932	17,865	44,154	.....	.....	.....	3,778	33
15,587	6,554	40,823	32,788	98,881	19,168	64,886	554,203	343,721	525,750	110	26,725	1,010	608	34
290	35	2,796	1,743	1,673	.....	2,101	39,666	16,842	39,666	.....	.....	.....	.....	35
1,504	1,321	1,327	3,738	4,164	2,241	928	56,441	300	520	.....	.....	.....	55,921	36
21,859	68,078	88,675	71,979	141,907	179,616	44,269	1,187,128	627,829	1,057,540	204	128,918	202	264	37
5,140	15,169	28,049	4,729	22,873	.....	3,761	144,069	42,483	144,069	.....	.....	.....	.....	38
473	739	2,133	2,123	1,709	2,750	38,963	30,448	16,119	19,112	.....	.....	.....	11,336	39
437	700	2,154	1,709	1,181	.....	18,408	31,987	12,858	27,012	.....	.....	1,500	3,475	40
1,679	1,381	4,273	8,215	9,091	955	37,641	101,125	77,035	99,042	.....	.....	.....	2,083	41
2,812	10,481	25,207	28,440	19,858	25,111	134,843	319,396	104,445	170,691	124,365	.....	.....	24,339	42
460	6,879	14,017	2,351	9,010	33,530	1,070	52,883	10,100	40,375	.....	.....	.....	12,508	43
1,415	2,187	3,068	3,064	4,632	24,572	3,036	41,099	8,711	38,956	.....	.....	.....	2,143	44
669	1,678	769	1,965	2,464	6,604	4,613	28,318	11,358	26,644	.....	.....	.....	1,674	45
315	6,740	3,705	3,215	28,618	64,215	1,000	48,564	9,450	22,125	.....	.....	.....	26,439	46
930	1,860	766	4,522	3,691	125	7,441	50,212	32,145	42,195	.....	7,801	.....	216	47
3,852	6,006	11,572	10,114	11,540	11,151	8,566	244,999	61,753	184,170	.....	.....	3,605	57,224	48
29	612	363	1,747	4,839	1,230	757	27,147	16,510	27,147	.....	.....	.....	.....	49
1,435	1,017	36,447	6,813	21,014	42,868	1,686	110,429	36,367	109,829	.....	.....	.....	600	50
17	932	2,545	867	49,824	1,500	2,013	66,971	8,351	66,937	.....	.....	.....	34	51

TABLE 71.—AVERAGE NUMBER OF EMPLOYEES AND TOTAL SALARIES

	STATE OR TERRITORY.	Number of stations.	SALARIED OFFICIALS AND CLERKS.								WAGE-EARNERS.			
			Total.		General officers.		Other officers, managers, superintendents, etc.		Clerks.		Total.		Foremen.	
			Number.	Salaries.	Number.	Salaries.	Number.	Salaries.	Number.	Salaries.	Average number.	Wages.	Average number.	Wages.
1	United States	2,805	6,046	$5,206,199	1,416	$1,465,471	1,875	$2,088,298	2,755	$1,652,430	20,863	$13,560,771	943	$910,972
2	Alabama	16	35	27,802	6	8,925	12	12,567	17	6,310	103	49,287	5	2,695
3	Arizona	13	28	30,545	4	6,000	13	16,750	11	7,795	58	52,099	2	2,200
4	Arkansas	34	30	22,810	8	5,247	12	12,480	10	5,083	101	54,544	4	3,140
5	California	105	835	385,769	68	122,318	115	136,204	152	127,247	976	758,678	83	89,286
6	Colorado	46	155	141,885	27	40,429	43	60,132	85	41,324	430	339,063	26	32,346
7	Connecticut	35	99	102,972	34	39,400	26	37,709	39	25,863	385	216,086	17	16,507
8	Florida	21	22	11,359	2	915	11	7,630	9	2,814	72	34,721	4	3,170
9	Georgia	24	36	21,200	7	4,700	19	13,380	10	3,120	90	39,483	5	3,280
10	Idaho	18	22	19,340	4	2,580	11	13,520	7	3,240	62	44,409	9	7,870
11	Illinois	264	525	444,702	78	78,270	147	161,700	300	204,732	1,400	871,165	67	60,705
12	Indiana	118	181	122,717	40	21,168	82	73,297	59	28,252	526	299,220	21	16,400
13	Indian Territory	10	7	5,850	1	900	4	3,930	2	1,020	27	16,100	1	450
14	Iowa	131	158	101,473	40	22,392	65	55,004	53	24,077	447	242,523	17	11,968
15	Kansas	50	68	40,216	12	6,360	27	22,988	29	10,868	188	108,218	6	5,014
16	Kentucky	50	67	55,770	10	10,070	36	36,294	21	9,406	261	139,409	5	3,936
17	Louisiana	15	64	58,018	23	24,799	6	8,418	35	24,801	226	143,126	4	2,692
18	Maine	50	87	49,564	26	12,216	34	26,569	27	10,779	246	148,398	14	11,601
19	Maryland	27	78	51,612	24	14,584	21	17,082	33	19,946	237	141,834	4	3,720
20	Massachusetts	97	420	448,221	112	142,815	119	179,058	189	126,353	1,474	1,058,344	36	39,814
21	Michigan	120	205	148,582	39	40,678	59	57,489	107	50,415	652	361,702	27	21,195
22	Minnesota	68	125	94,378	13	12,050	45	48,304	67	34,024	347	231,973	9	9,040
23	Mississippi	25	29	18,157	13	7,350	6	5,860	10	4,947	104	47,716	8	4,910
24	Missouri	80	183	166,408	53	64,725	32	32,805	98	68,878	681	443,802	47	47,165
25	Montana	26	50	71,832	9	14,071	19	36,645	22	21,116	146	143,266	15	18,806
26	Nebraska	43	44	37,149	13	12,831	19	17,470	12	6,848	156	94,969	5	4,150
27	Nevada	5	7	5,400	2	1,500	4	3,300	1	600	11	9,376	1	1,095
28	New Hampshire	50	77	46,580	38	17,370	18	19,274	21	9,936	216	140,758	15	12,766
29	New Jersey	60	254	263,831	51	83,016	48	78,946	155	101,869	804	548,687	36	31,075
30	New Mexico	11	12	11,320	2	1,600	7	8,160	3	1,560	33	23,420	2	2,220
31	New York	228	869	801,844	192	261,465	186	237,106	491	303,273	4,427	3,035,971	179	196,510
32	North Carolina	22	30	18,864	8	6,380	13	9,162	9	3,322	56	26,456	2	1,980
33	North Dakota	13	15	10,360	.....	.....	9	8,860	6	1,500	36	22,110	.....	.....
34	Ohio	145	284	209,940	63	65,399	103	97,547	118	46,994	1,026	636,515	37	33,506
35	Oklahoma	8	12	12,410	4	4,040	3	4,770	5	3,600	39	23,249	2	1,560
36	Oregon	33	42	56,380	5	19,400	20	24,180	17	14,800	136	103,835	7	8,040
37	Pennsylvania	243	667	511,580	186	118,564	212	233,140	269	159,876	2,327	1,468,472	91	82,790
38	Rhode Island	6	36	70,404	4	32,680	8	16,550	24	21,174	234	165,990	11	12,261
39	South Carolina	16	27	21,454	3	4,780	14	13,400	10	3,274	89	39,631	3	3,220
40	South Dakota	22	18	14,918	1	1,125	12	11,560	5	2,233	54	35,678	4	3,450
41	Tennessee	35	39	41,506	8	15,664	14	13,880	17	11,962	194	99,696	6	5,036
42	Texas	130	165	123,467	25	25,294	64	61,373	76	36,800	561	355,339	33	27,480
43	Utah	15	68	56,568	18	10,320	26	32,955	24	13,308	170	119,248	9	8,130
44	Vermont	41	70	34,496	48	18,690	11	10,212	11	5,594	134	83,629	12	10,093
45	Virginia	27	43	18,205	18	6,471	15	8,674	10	3,060	80	33,854	4	2,880
46	Washington	33	61	56,365	13	18,680	25	28,007	23	11,678	157	119,825	13	14,315
47	West Virginia	35	42	18,875	19	5,550	12	9,625	11	3,700	106	58,586	3	3,020
48	Wisconsin	124	111	74,894	27	11,410	59	53,040	25	10,444	390	219,669	20	15,365
49	Wyoming	13	13	11,950	5	3,080	5	6,180	3	2,690	40	34,175	7	7,260
50	All other states[1]	4	31	32,242	10	17,200	4	5,117	17	9,925	148	81,450	5	4,860
51	Alaska and Hawaii	4	26	25,387	5	728	6	13,439	15	11,220	75	63,767	2	2,400

[1] Includes states having less than 3 stations, in order that the operations of individual stations may not be disclosed. These stations are distributed as follows: Delaware, 2; District of Columbia, 2.

AND WAGES—PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902.

WAGE-EARNERS—continued.																
Inspectors.		Engineers.		Firemen.		Dynamo and switchboard men.		Linemen.		Mechanics.		Lamp trimmers.		All other wage-earners.		
Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	
546	$397,983	3,743	$2,721,127	2,951	$1,717,149	1,872	$1,286,065	3,868	$2,510,269	1,009	$768,694	2,318	$1,460,046	3,613	$1,788,466	1
2	1,086	19	12,487	19	7,329	3	2,298	29	14,209	1	936	10	4,468	15	3,784	2
.....	.....	18	19,765	12	7,690	7	5,405	11	10,770	.....	.....	4	3,120	4	3,149	3
1	220	29	17,902	17	8,061	10	6,120	18	9,240	3	1,440	4	2,056	15	6,365	4
29	24,248	94	85,704	79	60,804	194	155,130	198	151,278	33	25,963	74	54,755	192	111,490	5
8	5,880	58	59,881	59	44,989	38	32,202	78	58,695	16	17,196	38	29,026	109	58,868	6
4	4,420	47	41,633	32	21,273	30	21,941	50	36,282	9	7,437	47	27,761	149	38,882	7
2	1,100	24	14,620	17	6,839	1	235	18	5,584	1	468	5	1,650	.....	1,055	8
1	1,000	19	11,310	23	7,117	8	3,966	19	7,872	1	600	5	1,745	9	2,593	9
1	1,200	12	8,905	4	2,630	11	8,870	17	10,835	5	3,099	3	1,500	.....	.....	10
45	27,741	377	248,272	235	129,403	104	65,141	238	152,507	45	29,231	179	106,290	110	51,875	11
15	10,072	152	92,203	90	42,650	23	14,281	81	48,739	8	5,594	82	46,520	54	22,761	12
.....	.....	11	8,010	4	2,100	.....	.....	10	5,240	.....	.....	.....	.....	1	300	13
3	2,027	157	96,476	112	50,398	14	7,776	73	39,739	7	3,861	27	15,491	37	14,787	14
8	5,200	55	35,398	36	19,231	9	5,014	42	24,010	10	5,278	13	6,606	9	2,467	15
2	1,400	59	37,774	41	18,897	9	5,716	42	20,674	6	4,500	23	12,437	74	34,075	16
9	7,270	27	22,118	24	13,896	21	12,188	42	28,235	10	8,576	31	18,377	58	29,774	17
4	3,080	20	14,450	21	11,225	59	37,307	55	31,618	10	6,293	16	8,887	47	23,827	18
14	9,680	40	27,884	39	23,076	28	12,155	42	27,999	10	7,200	37	18,080	28	12,040	19
71	51,183	199	181,735	159	110,358	130	99,861	247	173,729	40	39,142	145	93,407	447	264,115	20
40	17,234	126	84,502	92	45,500	81	45,096	113	66,666	15	10,077	62	33,229	96	38,203	21
10	8,320	87	63,441	47	26,626	29	19,160	72	46,650	29	17,460	32	20,486	32	20,790	22
2	1,145	26	14,134	29	10,955	4	2,580	18	8,019	.....	.....	6	2,675	11	3,298	23
39	31,557	101	68,501	114	59,794	30	19,740	121	84,501	52	38,289	60	38,294	117	55,961	24
7	6,580	26	27,307	9	7,789	37	34,446	21	31,432	3	2,141	10	9,998	18	4,772	25
4	2,690	48	27,457	22	12,434	16	9,790	44	25,069	5	2,640	5	3,010	12	7,729	26
1	1,200	2	1,560	.....	.....	4	3,955	.....	.....	.....	.....	1	480	2	1,086	27
1	600	25	20,427	17	10,998	55	33,098	41	27,686	4	2,777	24	14,953	34	17,448	28
31	19,913	135	110,148	105	69,271	56	33,925	185	123,980	33	23,495	115	77,828	108	59,052	29
.....	.....	11	9,059	6	3,800	.....	.....	8	5,851	.....	.....	3	1,680	3	810	30
65	57,454	451	370,526	557	358,140	413	302,717	708	457,512	383	317,936	616	417,656	1,055	557,520	31
.....	.....	17	9,021	10	3,729	9	4,480	9	4,023	.....	.....	4	1,759	5	1,516	32
.....	.....	17	11,270	8	4,860	.....	.....	5	3,560	2	940	2	1,080	2	400	33
27	17,047	221	158,320	162	92,869	53	33,471	226	134,597	34	24,574	150	87,465	116	54,666	34
.....	.....	11	8,080	8	4,380	.....	.....	9	5,305	.....	.....	4	1,744	5	2,180	35
4	3,120	40	34,335	20	13,665	20	14,255	13	10,380	5	4,500	20	12,800	7	2,740	36
53	39,851	471	322,964	383	223,575	140	87,945	522	330,737	176	120,627	267	167,170	224	92,813	37
5	4,580	24	19,446	18	13,178	19	14,929	35	24,825	5	3,675	33	23,593	84	49,553	38
.....	.....	17	9,963	18	5,818	13	8,170	15	6,296	1	400	5	1,820	17	3,944	39
.....	.....	22	14,732	9	4,936	5	3,480	9	5,333	1	900	3	2,447	1	400	40
8	6,837	35	19,579	30	13,014	14	8,080	26	12,314	11	7,440	17	8,201	47	19,195	41
8	6,821	162	108,485	89	47,466	25	15,582	133	89,877	4	3,060	29	20,119	78	36,449	42
6	4,542	9	8,641	6	3,820	41	25,903	38	29,520	4	3,100	12	9,105	45	26,487	43
4	3,580	17	12,351	15	8,463	39	22,592	22	14,822	2	1,325	10	5,472	13	5,431	44
.....	.....	23	11,359	14	4,425	6	3,126	17	6,412	2	1,398	6	2,240	8	2,014	45
3	2,787	31	24,741	23	14,923	19	14,580	32	26,338	1	1,080	11	7,606	24	13,455	46
.....	.....	48	29,763	17	8,289	1	360	20	10,206	4	2,148	5	2,424	8	2,376	47
.....	.....	106	65,486	72	37,119	36	20,531	86	50,311	2	1,057	41	21,886	27	7,914	48
.....	.....	11	9,440	7	5,040	3	2,700	7	6,185	1	960	2	1,440	2	1,150	49
9	5,368	11	9,452	21	14,307	10	6,318	8	5,157	15	9,861	20	9,220	49	16,907	50
4	3,115	6	8,550	5	4,680	8	5,100	13	9,450	9	7,500	2	900	26	22,072	51

TABLE 72.—ANALYSIS OF MISCELLANEOUS EXPENSES—PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902.

STATE OR TERRITORY.	Number of stations.	Total expenses.	Rent of stations, supports, conduits, etc.	Rent of offices.	Taxes.	Injuries and damages.	Insurance.	Ordinary repairs of buildings and machinery.	All other expenses.
United States	2,805	$11,456,037	$1,001,504	$270,446	$2,654,885	$246,545	$827,926	$2,480,217	$3,974,514
Alabama	16	41,036	4,334	1,108	6,970	450	3,250	12,680	12,244
Arizona	13	22,620	120	2,643	6,344	529	1,425	6,773	4,786
Arkansas	34	32,506	282	1,452	6,350	57	5,034	7,027	12,304
California	105	669,058	12,679	22,955	124,284	30,583	41,866	167,007	269,684
Colorado	46	290,991	2,090	12,823	70,765	952	22,290	56,995	125,076
Connecticut	35	121,385	2,824	3,666	26,099	3,424	13,655	36,909	34,808
Florida	21	12,480	50	460	4,206	.....	2,421	3,807	1,536
Georgia	24	17,429	48	396	6,261	.....	1,608	4,313	4,803
Idaho	18	23,140	2,115	1,798	5,045	250	1,793	5,541	6,598
Illinois	264	800,533	35,767	27,288	152,076	31,487	64,301	90,138	399,476
Indiana	118	192,412	1,541	7,688	55,425	1,808	18,208	46,954	60,788
Indian Territory	10	6,216	33	138	1,115	.....	1,605	1,827	1,498
Iowa	131	143,879	4,982	6,585	29,614	4,876	15,058	36,508	46,256
Kansas	50	70,310	251	1,951	16,997	1,415	6,005	23,081	20,610
Kentucky	50	179,632	121,205	2,160	17,040	2,700	10,161	10,908	15,458
Louisiana	15	84,063	.....	3,396	35,355	320	7,244	12,512	25,236
Maine	50	101,387	3,314	1,186	18,402	3,007	8,774	30,043	36,661
Maryland	27	114,847	500	3,432	26,477	5,442	5,044	30,260	43,692
Massachusetts	97	1,272,372	28,039	15,098	296,444	4,221	91,121	509,198	328,251
Michigan	120	214,725	5,745	7,969	54,580	5,864	22,706	59,125	58,736
Minnesota	68	186,596	2,520	4,946	40,991	5,500	14,255	62,278	56,106
Mississippi	25	26,253	331	1,163	5,762	.....	3,061	5,553	10,383
Missouri	80	263,927	3,904	17,376	79,161	2,700	17,174	43,852	99,760
Montana	26	122,294	10,700	5,470	28,996	1,471	7,252	36,768	31,637
Nebraska	43	64,068	1,041	2,015	16,322	1,157	7,990	15,487	20,056
Nevada	5	3,391	150	150	1,550	.....	255	706	580
New Hampshire	50	96,126	4,605	2,905	23,621	475	14,620	28,022	21,878
New Jersey	60	431,438	7,655	15,068	121,131	22,257	31,289	81,040	152,998
New Mexico	11	14,009	1,080	420	2,787	365	999	3,925	4,433
New York	228	2,643,571	652,897	25,539	719,669	59,344	154,317	269,950	761,855
North Carolina	22	12,848	315	400	3,112	10	1,949	3,673	3,389
North Dakota	13	17,217	60	780	4,157	.....	1,564	3,900	6,756
Ohio	145	586,764	3,670	12,095	99,936	12,734	24,409	175,565	258,355
Oklahoma	8	9,255	72	396	2,250	.....	1,528	2,120	2,889
Oregon	33	69,604	1,312	1,505	20,080	.....	9,914	10,643	26,150
Pennsylvania	243	1,297,557	16,008	29,679	294,181	5,054	84,057	301,152	567,426
Rhode Island	6	217,313	20	2,536	56,675	800	28,043	63,379	65,860
South Carolina	16	24,750	230	664	8,018	215	2,510	5,967	7,146
South Dakota	22	17,170	.....	426	4,073	.....	2,290	4,624	5,757
Tennessee	35	89,069	2,030	1,714	26,420	604	8,215	24,214	25,872
Texas	130	254,992	1,875	6,953	37,607	2,665	27,835	93,924	84,133
Utah	15	118,517	45,256	4,196	18,882	5,841	701	2,245	41,396
Vermont	41	47,119	5,786	2,237	8,392	741	4,961	7,554	17,448
Virginia	27	18,593	1,818	760	2,873	330	1,846	5,409	5,557
Washington	33	81,480	2,980	2,392	14,566	771	5,411	15,466	9,894
West Virginia	35	26,244	1,197	1,242	4,607	.....	3,099	6,889	9,210
Wisconsin	124	121,389	7,895	2,967	34,515	613	14,603	29,156	31,640
Wyoming	13	18,325	78	260	3,439	.....	2,588	6,560	5,400
All other states[1]	4	165,137	100	.....	11,263	25,513	7,622	18,590	102,049
Alaska and Hawaii	4	44,612	3,103	3,360	11,946	.....	4,568	6,136	15,499

[1] Includes states having less than 3 stations, in order that the operations of individual stations may not be disclosed. These stations are distributed as follows: Delaware, 2; District of Columbia, 2.

TABLE 73.—ELECTRIC LINE CONSTRUCTION—PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902.

STATE OR TERRITORY.	Number of stations.	AGGREGATE, MILES.		LIGHTING AND STATIONARY MOTOR SERVICE, MILES.								ELECTRIC RAILWAY CAR SERVICE OWNED BY LIGHTING COMPANIES, MILES.	
				Total.		Underground.		Overhead.		Submarine.			
		Mains.	Feeders.	Mains.	Feeders.	Mains.	Feeders.	Mains.	Feeders.	Mains.	Feeders.	Mains.	Feeders.
United States	2,805	93,352.95	16,452.28	93,273.45	16,332.03	5,408.55	2,262.02	87,833.63	14,061.50	31.27	8.51	79.50	120.25
Alabama	16	367.50	47.05	367.50	47.05	2.00	.....	365.50	47.05	.....	.....	.....	.....
Arizona	13	99.25	20.25	99.25	20.25	.....	.....	99.25	20.25	.....	.....	.....	.....
Arkansas	34	367.03	76.00	367.03	76.00	.....	.....	367.03	76.00	.....	.....	.....	.....
California	105	4,463.54	335.57	4,457.34	335.57	192.81	36.40	4,264.53	299.17	.....	.....	6.00	.....
Colorado	46	1,034.06	317.37	1,034.06	317.37	.....	.....	1,034.06	317.37	.....	.....	.....	.....
Connecticut	35	1,680.53	281.81	1,680.53	281.81	12.10	7.50	1,668.43	274.31	.....	.....	.....	.....
Florida	21	226.00	15.75	226.00	15.75	.....	.....	226.00	15.75	.....	.....	.....	.....
Georgia	24	292.00	7.00	292.00	7.00	.....	.....	292.00	7.00	.....	.....	.....	.....
Idaho	18	144.25	63.50	144.25	63.50	.....	.....	144.25	63.50	.....	.....	.....	.....
Illinois	264	5,374.80	876.68	5,374.80	876.68	232.09	66.62	5,124.61	810.06	18.10	.....	.....	.....
Indiana	118	3,242.62	366.65	3,240.62	366.40	220.00	85.00	3,020.62	281.40	.....	.....	2.00	0.25
Indian Territory	10	117.22	13.00	117.22	13.00	.....	.....	117.22	13.00	.....	.....	.....	.....
Iowa	131	1,673.21	509.72	1,664.71	502.72	5.80	13.40	1,658.91	489.32	.....	.....	8.50	7.00
Kansas	50	815.25	90.83	815.25	90.83	.....	.....	815.25	90.83	.....	.....	.....	.....
Kentucky	50	775.50	79.00	771.50	79.00	1.00	.....	770.50	79.00	.....	.....	4.00	.....
Louisiana	15	265.08	156.73	265.08	126.73	49.50	37.00	215.58	89.73	.....	.....	.....	30.00
Maine	50	1,186.00	467.65	1,186.00	467.65	.....	.....	1,186.00	467.65	.....	.....	.....	.....
Maryland	27	5,827.00	748.04	5,827.00	748.04	.....	5.00	5,827.00	743.04	.....	.....	.....	.....
Massachusetts	97	11,415.55	962.38	11,415.55	954.38	1,657.83	17.55	9,757.55	936.83	0.17	.....	.....	8.00
Michigan	120	2,180.15	419.03	2,180.15	419.03	15.61	29.72	2,161.63	389.31	2.91	.....	.....	.....
Minnesota	68	1,191.80	336.14	1,191.80	336.14	88.50	89.95	1,103.30	246.19	.....	.....	.....	.....
Mississippi	25	326.00	31.00	326.00	31.00	.....	.....	326.00	31.00	.....	.....	.....	.....
Missouri	80	2,801.26	455.27	2,801.26	455.27	100.72	55.20	2,700.54	400.07	.....	.....	.....	.....
Montana	26	493.19	143.50	493.19	143.50	.....	.....	493.19	143.50	.....	.....	.....	.....
Nebraska	43	1,335.75	68.75	1,335.75	68.75	.....	.....	1,335.75	68.75	.....	.....	.....	.....
Nevada	5	24.00	2.50	24.00	2.50	.....	.....	24.00	2.50	.....	.....	.....	.....
New Hampshire	50	1,255.50	165.50	1,255.50	135.50	.....	.....	1,252.50	135.50	3.00	.....	.....	30.00
New Jersey	60	5,325.90	678.98	5,325.90	678.98	37.40	25.25	5,286.75	652.17	1.75	1.56	.....	.....
New Mexico	11	96.50	29.00	96.50	29.00	.....	.....	96.50	29.00	.....	.....	.....	.....
New York	228	11,139.17	1,932.80	11,094.17	1,932.80	1,325.11	303.12	9,769.06	1,626.78	.....	2.90	45.00	.....
North Carolina	22	231.60	31.00	231.60	31.00	.....	.....	231.60	31.00	.....	.....	.....	.....
North Dakota	13	82.00	27.00	82.00	27.00	.....	.....	82.00	27.00	.....	.....	.....	.....
Ohio	145	5,444.12	351.57	5,444.12	351.57	419.25	16.92	5,024.87	332.85	.....	1.80	.....	.....
Oklahoma	8	229.00	22.00	229.00	22.00	.....	.....	229.00	22.00	.....	.....	.....	.....
Oregon	33	824.07	614.26	824.07	614.26	.....	.....	822.07	614.26	2.00	.....	.....	.....
Pennsylvania	243	11,382.01	2,949.28	11,368.01	2,924.28	668.50	500.00	10,699.51	2,424.28	.....	.....	14.00	[1] 25.00
Rhode Island	6	2,593.50	1,086.00	2,593.50	1,086.00	142.00	947.00	2,450.50	138.00	1.00	1.00	.....	.....
South Carolina	16	184.15	51.00	184.15	51.00	.....	.....	184.15	51.00	.....	.....	.....	.....
South Dakota	22	192.00	13.00	192.00	13.00	.....	.....	192.00	13.00	.....	.....	.....	.....
Tennessee	35	600.95	467.25	600.95	447.25	30.00	10.00	570.95	437.25	.....	.....	.....	20.00
Texas	130	1,186.38	123.00	1,186.38	123.00	.....	.....	1,186.38	123.00	.....	.....	.....	.....
Utah	15	476.73	77.89	476.73	77.89	.....	.....	476.73	77.89	.....	.....	.....	.....
Vermont	41	1,141.96	223.18	1,141.96	223.18	.....	.....	1,141.96	223.18	.....	.....	.....	.....
Virginia	27	171.47	136.78	171.47	136.78	.....	.....	171.47	136.78	.....	.....	.....	.....
Washington	33	262.91	88.42	262.91	88.42	15.25	3.25	246.76	85.17	0.90	.....	.....	.....
West Virginia	35	350.08	75.05	350.08	75.05	.....	.....	349.70	75.05	0.38	.....	.....	.....
Wisconsin	124	2,046.51	330.06	2,046.51	330.06	2.78	0.50	2,043.67	328.31	0.06	1.25	.....	.....
Wyoming	13	68.00	26.75	68.00	26.75	.....	.....	68.00	26.75	.....	.....	.....	.....
All other states[1]	4	350.10	61.34	350.10	61.34	190.30	12.64	158.80	48.70	1.00	.....	.....	.....
Alaska and Hawaii	4	111.00	7.90	111.00	7.90	.....	.....	111.00	7.50	.....	0.40	.....	.....

[1] Includes states having less than 3 stations, in order that the operations of individual stations may not be disclosed. These stations are distributed as follows: Delaware, 2; District of Columbia, 2.

TABLE 74.—POWER AND GENERATING EQUIPMENT—

	STATE OR TERRITORY.	Number of stations.	STEAM ENGINES.								WATER WHEELS.							
			Total.		500 horsepower and under.		Over 500 and under 1,000 horsepower.		1,000 horsepower and over.		Total.		500 horsepower and under.		Over 500 and under 1,000 horsepower.		1,000 horsepower and over.	
			Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
1	United States	2,805	4,870	1,232,923	4,407	715,418	266	184,670	197	332,835	1,308	427,254	1,112	164,981	84	56,520	112	205,753
2	Alabama	16	28	6,660	25	4,060	2	1,600	1	1,000								
3	Arizona	13	20	1,890	20	1,890												
4	Arkansas	34	53	7,116	52	6,566	1	550			2	227	2	227				
5	California	105	139	52,565	114	23,315	17	13,200	8	16,050	130	78,483	79	12,771	23	15,574	28	50,138
6	Colorado	46	97	24,998	85	13,298	9	7,200	3	4,500	42	12,750	34	5,425	6	4,325	2	3,000
7	Connecticut	35	77	20,140	70	13,240	5	3,300	2	3,600	31	6,565	29	4,265			2	2,300
8	Florida	21	39	4,221	39	4,221												
9	Georgia	24	27	3,853	27	3,853					10	5,989	6	839			4	5,150
10	Idaho	18	14	1,480	14	1,480					23	3,924	23	3,924				
11	Illinois	264	448	95,592	416	57,702	16	10,490	16	27,400	52	9,505	52	9,505				
12	Indiana	118	191	39,501	181	31,701	8	5,300	2	2,500	6	600	6	600				
13	Indian Territory	10	12	1,475	12	1,475												
14	Iowa	131	191	30,714	183	23,114	6	3,550	2	4,050	31	2,399	31	2,399				
15	Kansas	50	70	10,746	68	9,246	2	1,500			10	974	10	974				
16	Kentucky	50	87	19,460	74	10,410	12	7,700	1	1,350	1	30	1	30				
17	Louisiana	15	32	12,187	24	3,787	4	2,550	4	5,900								
18	Maine	50	57	11,080	55	9,780	2	1,300			52	12,671	43	6,471	9	6,200		
19	Maryland	27	79	18,425	72	12,775	4	2,650	3	3,000	6	275	6	275				
20	Massachusetts	97	327	108,854	279	54,374	31	21,780	17	32,700	39	8,808	36	5,973	3	2,835		
21	Michigan	120	159	31,076	153	26,576	5	3,500	1	1,000	95	12,915	95	12,915				
22	Minnesota	68	96	19,074	91	12,924	1	650	4	5,500	20	5,125	17	2,625	3	2,500		
23	Mississippi	25	37	4,775	37	4,775												
24	Missouri	80	133	36,432	116	18,282	8	4,650	9	13,500	2	1,000	2	1,000				
25	Montana	26	24	7,585	21	3,185			3	4,350	44	24,000	28	5,000			16	19,000
26	Nebraska	43	52	8,975	50	6,725	1	750	1	1,500	9	1,820	9	1,820				
27	Nevada	5	4	250	4	250					4	1,470	3	870	1	600		
28	New Hampshire	50	42	12,490	38	7,490	1	800	3	4,200	78	15,406	76	13,406			2	2,000
29	New Jersey	60	165	65,400	122	24,415	25	16,800	18	24,185	14	1,005	14	1,005				
30	New Mexico	11	21	1,780	21	1,780					1	50	1	50				
31	New York	228	447	184,806	359	61,306	40	26,550	48	96,950	236	128,271	189	29,685	12	6,986	35	91,600
32	North Carolina	22	25	2,740	25	2,740					8	1,780	7	1,030	1	750		
33	North Dakota	13	21	2,870	21	2,870					1	100	1	100				
34	Ohio	145	310	82,888	277	46,538	19	13,200	14	23,150	10	1,826	10	1,826				
35	Oklahoma	8	14	2,570	14	2,570												
36	Oregon	33	32	6,347	30	3,547			2	2,800	44	11,118	33	4,518	11	6,600		
37	Pennsylvania	243	610	157,720	559	100,470	28	21,300	23	35,950	48	6,703	46	5,403	2	1,300		
38	Rhode Island	6	27	15,550	19	6,800	5	4,250	3	4,500	11	1,925	11	1,925				
39	South Carolina	16	24	9,430	21	3,430			3	6,000	9	10,415	1	250			8	10,165
40	South Dakota	22	23	3,230	23	3,230					7	845	7	845				
41	Tennessee	35	65	14,380	62	10,780	1	600	2	3,000	5	439	5	439				
42	Texas	130	195	30,415	189	25,865	4	2,550	2	2,000	12	1,104	12	1,104				
43	Utah	15	9	2,050	9	2,050					25	18,285	10	3,085	4	2,800	11	12,400
44	Vermont	41	34	7,196	34	7,196					64	13,075	55	7,025	9	6,050		
45	Virginia	27	28	3,167	28	3,167					9	1,041	9	1,041				
46	Washington	33	32	4,963	30	3,513	2	1,450			41	17,288	37	7,288			4	10,000
47	West Virginia	35	52	8,649	50	7,449	2	1,200			1	100	1	100				
48	Wisconsin	124	154	23,293	153	22,543	1	750			74	7,423	74	7,423				
49	Wyoming	13	25	2,654	25	2,654					1	75	1	75				
50	All other states[1]	4	22	9,311	16	4,111	4	3,000	2	2,200								
51	Alaska and Hawaii	4	8	2,260	5	760	3	1,500			7	1,025	7	1,025				

[1] Includes states having less than 3 stations, in order that the operations of individual stations may not be disclosed. These stations are distributed as follows: Delaware, 2; District of Columbia, 2.

PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902.

GAS ENGINES.		AUXILIARY STEAM ENGINES.		DYNAMOS.								BOOSTERS.		ROTARY CONVERTERS.		STORAGE BATTERY CELLS IN MAIN PLANTS.		
				Total.		Direct current, constant voltage.		Direct current, constant amperage.		Alternating and polyphase current.								
Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	
147	11,224	329	13,619	10,662	1,472,996	3,405	418,913	2,957	157,768	4,300	896,315	184	17,735	181	63,683	5,981	16,335	1
1	25	.....	.....	52	5,123	18	1,472	13	592	21	3,059	.....	.....	.....	.....	.....	.....	2
7	650	.....	.....	40	2,428	12	723	12	495	16	1,210	.....	.....	5	83	.....	.....	3
.....	.....	.....	.....	74	7,112	19	1,345	6	275	49	5,492	.....	.....	.....	.....	.....	.....	4
6	618	44	1,012	377	110,381	124	16,433	77	5,150	176	88,798	8	763	1	125	456	4,000	5
.....	.....	15	400	219	29,140	93	6,147	51	3,382	75	19,611	10	134	.....	.....	.....	.....	6
9	406	9	378	172	20,279	71	6,649	42	1,435	59	12,195	6	93	6	1,133	348	50	7
.....	.....	1	8	42	4,231	8	672	2	53	32	3,506	.....	.....	.....	.....	12	4	8
.....	.....	.....	.....	60	8,114	21	829	12	588	27	6,697	.....	.....	.....	.....	.....	.....	9
1	50	.....	.....	44	3,628	21	818	5	250	18	2,560	.....	.....	.....	.....	.....	.....	10
6	242	8	348	892	110,334	283	38,202	278	14,033	336	58,099	10	425	3	495	269	84	11
11	742	11	130	405	38,225	107	10,099	146	8,264	152	19,862	2	106	.....	.....	.....	.....	12
.....	.....	.....	.....	16	1,460	2	80	1	60	13	1,320	.....	.....	.....	.....	.....	.....	13
5	400	6	115	320	28,150	129	11,443	61	2,614	130	14,093	2	50	.....	.....	.....	.....	14
.....	.....	1	25	136	10,207	57	3,487	22	1,114	57	5,606	1	25	.....	.....	.....	.....	15
3	45	.....	.....	150	18,430	48	5,520	44	2,702	58	10,208	.....	.....	.....	.....	.....	.....	16
.....	.....	1	200	72	9,077	28	4,153	27	1,773	17	3,151	1	202	.....	.....	.....	.....	17
.....	.....	6	563	173	20,228	75	6,022	23	741	75	13,465	1	90	.....	.....	.....	.....	18
3	80	.....	.....	162	16,860	45	3,580	72	4,196	45	9,084	.....	.....	.....	.....	124	6	19
3	85	3	211	762	114,928	257	41,076	272	14,709	233	59,143	41	2,907	.....	.....	757	3,584	20
1	40	12	984	402	42,133	147	13,353	93	4,523	162	24,257	8	1,866	10	3,129	517	419	21
10	560	17	102	180	19,877	79	6,248	44	1,950	57	11,679	5	580	5	1,066	180	210	22
.....	.....	.....	.....	52	4,365	8	430	8	293	36	3,642	.....	.....	.....	.....	.....	.....	23
2	11	16	989	243	37,150	65	12,318	74	4,273	104	20,559	4	174	.....	.....	296	666	24
1	2	5	100	89	28,114	15	2,595	15	925	56	24,594	3	800	.....	.....	.....	.....	25
3	82	.....	.....	94	9,847	37	2,057	12	600	45	7,190	.....	.....	.....	.....	.....	.....	26
.....	.....	.....	.....	14	1,024	6	92	3	130	5	802	.....	.....	.....	.....	.....	.....	27
1	50	.....	.....	149	23,729	19	3,023	39	1,822	91	18,884	7	424	2	800	128	35	28
6	431	26	840	387	60,361	87	18,900	158	8,976	142	32,485	6	436	1	400	.....	.....	29
.....	.....	.....	.....	32	1,321	22	697	3	183	7	441	.....	.....	.....	.....	.....	.....	30
13	2,005	34	2,331	1,408	245,823	323	60,404	395	18,992	690	166,427	35	4,638	65	44,300	809	1,223	31
.....	.....	1	4	53	3,332	25	771	12	435	16	2,126	.....	.....	.....	.....	.....	.....	32
.....	.....	.....	.....	26	2,096	20	1,531	1	20	5	545	1	20	.....	.....	.....	.....	33
13	755	46	781	624	76,276	213	37,375	233	12,587	178	26,314	4	350	5	2,230	310	2,372	34
.....	.....	.....	.....	22	2,367	5	455	6	397	11	1,515	.....	.....	.....	.....	.....	.....	35
.....	.....	2	20	84	14,609	13	1,195	23	1,153	48	12,261	.....	.....	5	2,600	.....	.....	36
16	1,587	16	1,369	1,215	155,377	379	45,353	431	26,231	405	83,793	6	320	15	4,402	799	2,157	37
.....	.....	7	25	121	16,147	28	6,845	55	2,544	38	6,758	5	495	.....	.....	568	715	38
.....	.....	1	100	37	16,820	3	385	5	212	29	16,223	.....	.....	1	30	.....	.....	39
4	145	1	150	47	3,213	21	1,032	6	176	20	2,005	.....	.....	.....	.....	.....	.....	40
.....	.....	6	413	95	16,244	29	4,939	15	836	51	10,469	3	285	2	1,100	264	197	41
2	108	12	1,015	307	32,157	113	8,475	25	1,153	169	22,529	8	2,159	.....	.....	.....	.....	42
.....	.....	.....	.....	55	18,617	17	2,160	10	800	28	15,657	.....	.....	2	1,100	.....	.....	43
1	125	.....	.....	98	12,918	19	2,015	23	864	56	10,039	.....	.....	.....	.....	.....	.....	44
.....	.....	4	23	54	3,789	20	819	2	90	32	2,880	.....	.....	.....	.....	.....	.....	45
.....	.....	9	93	103	17,705	48	5,635	21	893	34	11,177	1	5	.....	.....	.....	.....	46
7	620	.....	.....	73	8,413	24	1,845	9	518	40	6,050	.....	.....	.....	.....	.....	.....	47
10	860	9	890	334	27,779	149	11,331	55	2,608	130	13,840	2	160	.....	.....	.....	.....	48
2	500	.....	.....	37	2,455	20	880	3	60	14	1,515	.....	.....	.....	.....	.....	.....	49
.....	.....	.....	.....	59	10,603	30	7,005	17	1,098	12	2,500	4	228	3	690	144	613	50
.....	.....	3	298	15	2,938	6	530	.....	.....	9	2,408	.....	.....	1	300	.....	.....	51

TABLE 75.—SUBSTATION EQUIPMENT, TRANSFORMERS, METERS, OUTPUT

	STATE OR TERRITORY.	Number of stations.	SUBSTATION PLANTS.								
			Total horse-power.	Storage battery cells.		Transformers.		Rotary converters.		Miscellaneous.	
				Number.	Horse-power.	Number.	Horse-power.	Number.	Horse-power.	Number.	Horse-power.
1	United States	2,805	574,167	8,388	25,284	1,765	418,068	168	109,546	135	21,269
2	Alabama	16									
3	Arizona	13									
4	Arkansas	34									
5	California	105	152,114	950	2,333	504	139,527	12	4,858	19	5,396
6	Colorado	46	10,696			57	10,496	1	200		
7	Connecticut	35	2,796	140	530	6	1,133	3	1,133		
8	Florida	21									
9	Georgia	24									
10	Idaho	18	1,340			10	1,340				
11	Illinois	264	27,786	912	5,590	91	15,951	19	5,470	10	775
12	Indiana	118	2,450	156	1,200	2	50	1	1,200		
13	Indian Territory	10	1,735	340	1,735						
14	Iowa	131	500			7	480			1	20
15	Kansas	50									
16	Kentucky	50									
17	Louisiana	15									
18	Maine	50									
19	Maryland	27	213	132	213						
20	Massachusetts	97	12,416	866	5,200	3	149			25	7,067
21	Michigan	120	15,121	160	600	54	14,521				
22	Minnesota	68	8,746	166	620	20	4,920	11	3,066	1	140
23	Mississippi	25									
24	Missouri	80	5,877	476	1,955	17	2,435	6	1,200	4	287
25	Montana	26	1,600			6	1,600				
26	Nebraska	43	310			4	310				
27	Nevada	5	1,067			4	1,067				
28	New Hampshire	50	8,723			36	8,723				
29	New Jersey	60	8,113	322	254	67	5,679	6	2,135	6	45
30	New Mexico	11									
31	New York	228	221,552	2,616	2,240	424	133,249	74	80,884	59	5,179
32	North Carolina	22	1,780			16	1,780				
33	North Dakota	13									
34	Ohio	145	2,372	166	1,333	8	490	4	549		
35	Oklahoma	8									
36	Oregon	33	8,674			97	6,542	4	2,132		
37	Pennsylvania	243	6,532	160	335	158	19,601	23	4,286	7	2,310
38	Rhode Island	6	2,630	296	550	18	2,080				
39	South Carolina	16	10,442	66	7	31	10,435				
40	South Dakota	22									
41	Tennessee	35									
42	Texas	130									
43	Utah	15	18,664			56	17,564	2	1,100		
44	Vermont	41	3,246	264	133	27	3,113				
45	Virginia	27	5			1	5				
46	Washington	33	15,666			29	14,333	2	1,333		
47	West Virginia	35									
48	Wisconsin	124	391	50	6	10	335			3	50
49	Wyoming	13									
50	All other states[1]	4	610	150	450	2	160				
51	Alaska and Hawaii	4									

[1] Includes states having less than 3 stations, in order that the operations of individual stations may not be disclosed. These stations are distributed as follows: Delaware, 2; District of Columbia, 2.

OF STATIONS—PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902.

TRANSFORMERS ON CIRCUITS FOR CONSUMERS.		METERS ON CONSUMERS' CIRCUITS.			OUTPUT OF STATIONS.				
					Kilowatt hours.		Horsepower hours of current.		
Number.	Horsepower.	Total.	Mechanical.	Chemical.	Total for year.	Average per day.	Total for year.	Average per day.	
179,300	820,968	526,011	518,428	7,583	2,311,146,676	6,413,012	3,083,212,074	8,566,231	1
701	2,533	1,430	1,430	.....	10,563,705	29,205	14,069,913	38,941	2
369	1,543	1,360	1,360	.....	3,662,045	10,033	4,882,726	13,378	3
1,283	5,944	2,777	2,777	.....	8,846,537	24,378	11,851,338	32,592	4
8,638	62,797	33,308	33,308	.....	150,338,307	412,233	200,571,886	550,013	5
6,876	12,999	14,252	14,228	24	60,090,854	165,514	80,284,992	221,098	6
1,928	10,710	9,016	9,016	.....	25,894,277	71,086	34,531,793	94,827	7
704	2,407	749	749	.....	5,139,190	14,571	6,852,241	19,428	8
740	2,415	515	515	.....	6,423,103	17,751	8,564,247	23,582	9
370	2,389	529	529	.....	4,782,359	18,191	6,360,270	24,262	10
12,473	54,170	56,312	53,584	2,728	133,882,667	371,456	178,542,947	496,646	11
6,363	19,854	13,053	13,053	.....	56,960,283	157,393	76,012,460	209,871	12
340	1,735	215	215	.....	1,196,411	3,389	1,595,226	4,519	13
4,073	15,432	13,957	13,957	.....	30,211,126	83,143	40,378,011	110,899	14
1,496	5,772	4,821	4,820	1	11,370,617	27,174	15,159,913	36,230	15
4,472	13,188	4,793	4,793	.....	24,491,499	67,351	32,630,318	89,803	16
1,157	4,558	5,168	5,168	.....	14,879,851	41,106	19,894,794	54,959	17
2,917	10,244	5,157	5,157	.....	21,417,570	59,083	28,345,863	78,375	18
2,641	11,615	4,567	4,567	.....	21,214,530	58,731	28,285,042	78,410	19
11,087	50,638	52,992	52,137	855	121,618,318	335,321	162,193,636	447,206	20
4,570	26,366	21,560	21,160	400	57,674,733	161,894	76,925,327	221,096	21
2,838	10,088	10,922	10,922	.....	29,144,817	79,908	39,242,588	106,790	22
1,419	5,250	1,385	1,385	.....	6,513,523	17,997	8,690,398	23,852	23
8,040	24,278	14,587	14,587	.....	49,756,499	137,004	66,363,558	182,751	24
907	6,127	4,773	4,773	.....	35,717,446	98,266	47,620,335	131,016	25
1,118	6,428	4,596	4,596	.....	10,806,500	29,751	14,437,902	39,747	26
82	450	68	68	.....	1,508,910	4,134	2,011,881	5,545	27
2,860	15,176	5,451	5,451	.....	27,053,673	74,103	36,073,144	98,849	28
9,381	37,921	20,830	20,830	.....	77,862,361	215,315	103,857,370	297,157	29
128	542	322	322	.....	2,637,810	7,390	3,496,837	9,852	30
17,009	186,031	71,932	70,491	1,441	695,017,187	1,909,259	927,868,745	2,547,003	31
395	1,799	721	721	.....	5,495,386	15,280	7,338,964	20,376	32
218	809	960	960	.....	4,540,130	12,442	5,512,711	15,141	33
7,866	33,615	25,507	25,083	424	101,536,499	284,504	135,422,716	380,194	34
269	2,033	879	879	.....	2,413,272	6,610	3,217,695	8,814	35
921	5,663	2,861	2,861	.....	16,980,730	46,722	22,617,488	62,253	36
27,824	74,527	55,568	54,198	1,370	230,070,709	666,215	306,717,868	890,225	37
2,477	6,023	6,041	6,041	.....	23,321,460	63,894	31,094,358	85,192	38
697	5,453	619	619	.....	16,573,550	45,669	22,105,591	60,896	39
582	2,201	1,374	1,284	90	3,807,008	10,529	5,070,998	14,039	40
1,898	9,228	5,925	5,925	.....	21,306,107	58,904	28,456,491	78,655	41
7,967	19,957	13,128	13,128	.....	46,210,310	127,709	61,623,175	170,274	42
947	6,200	5,987	5,987	.....	32,364,317	95,425	43,295,166	127,414	43
2,247	11,623	4,285	4,285	.....	18,605,800	51,005	24,902,470	67,905	44
798	2,647	628	628	.....	4,719,726	13,848	6,290,638	18,466	45
756	5,234	2,842	2,842	.....	18,783,847	51,743	24,938,467	68,968	46
1,805	6,724	1,787	1,787	.....	9,718,772	27,544	12,978,758	36,780	47
3,915	14,055	10,634	10,384	250	27,505,713	76,740	36,677,658	97,146	48
139	1,384	997	997	.....	3,883,285	10,529	5,177,365	14,036	49
649	2,193	3,871	3,871	.....	16,633,347	45,570	22,177,796	60,760	50
516	2,362	912	912	.....	3,430,600	9,196	4,567,568	12,259	51

TABLE 76.—ANALYSIS OF SERVICE—PRIVATE

	STATE OR TERRITORY.	Number of stations.	ARC LIGHTING—NUMBER OF LAMPS IN SERVICE.															
			Aggregate.	Total.				Direct current.				Alternating current.				All other.			
				Commercial or other private.		Public.		Commercial or other private.		Public.		Commercial or other private.		Public.		Commercial or other private.		Public.	
				Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.
1	United States...	2,805	334,908	41,622	126,558	108,082	58,641	36,856	64,998	96,659	22,861	3,631	60,454	2,681	35,635	1,135	1,111	8,742	145
2	Alabama	16	1,779	81	677	289	732	67	370	253	15	.....	187	.....	696	14	120	36	21
3	Arizona	13	295	57	105	62	71	56	27	62	.....	1	78	.....	71	.....	.....	.....	.....
4	Arkansas	34	1,321	72	944	67	238	45	464	32	25	27	480	35	202	.....	.....	.....	11
5	California	105	15,357	1,554	7,996	2,593	3,214	1,183	3,879	1,735	18	30	4,617	41	3,196	341	.....	817	.....
6	Colorado	46	4,758	1,200	1,434	1,647	477	1,200	320	1,647	73	.....	1,114	.....	404	.....	.....	.....	.....
7	Connecticut	35	6,150	428	2,182	1,952	1,588	426	1,751	1,952	368	2	431	.....	1,116	.....	.....	.....	104
8	Florida	21	504	22	154	143	185	22	13	37	25	.....	141	.....	160	.....	.....	106	.....
9	Georgia	24	659	8	92	428	131	8	30	402	22	.....	62	26	109	.....	.....	.....	.....
10	Idaho	18	543	78	274	116	75	78	33	116	11	.....	241	.....	64	.....	.....	.....	.....
11	Illinois	264	28,314	3,667	15,011	6,243	3,393	3,563	9,375	6,046	2,246	104	5,636	197	1,147	.....	.....	.....	.....
12	Indiana	118	11,121	554	3,423	5,717	1,427	546	1,893	5,717	793	.....	1,530	.....	634	8	.....	.....	.....
13	Indian Territory	10	197	30	100	11	56	30	9	11	5	.....	91	.....	51	.....	.....	.....	.....
14	Iowa	131	5,080	348	1,780	1,833	1,119	325	1,045	1,765	341	19	734	68	778	4	1	.....	.....
15	Kansas	50	2,722	430	1,229	820	243	416	637	640	111	8	587	180	132	6	5	.....	.....
16	Kentucky	50	3,856	657	499	2,310	390	304	174	2,159	108	353	325	86	282	.....	.....	65	.....
17	Louisiana	15	4,055	287	1,721	1,861	186	287	1,333	1,861	56	.....	388	.....	130	.....	.....	.....	.....
18	Maine	50	2,062	95	629	353	985	95	232	353	477	.....	397	.....	508	.....	.....	.....	.....
19	Maryland	27	5,264	1,661	1,607	1,435	561	1,661	180	1,435	555	.....	1,427	.....	6	.....	.....	.....	.....
20	Massachusetts	97	27,059	1,093	11,308	6,709	7,949	1,027	7,360	6,257	4,811	64	3,948	452	3,136	2	.....	.....	2
21	Michigan	120	10,474	1,023	5,716	1,854	1,881	764	3,037	1,735	586	59	2,577	114	1,295	200	102	5	.....
22	Minnesota	68	6,766	295	3,927	1,252	1,292	281	2,977	1,198	457	14	950	54	835	.....	.....	.....	.....
23	Mississippi	25	585	8	88	315	174	8	.....	305	22	.....	88	10	152	.....	.....	.....	.....
24	Missouri	80	11,447	3,666	6,096	987	698	3,344	2,508	984	660	282	3,578	3	38	40	10	.....	.....
25	Montana	26	1,605	253	821	312	219	250	298	288	2	.....	521	11	217	3	2	13	.....
26	Nebraska	43	2,239	185	1,115	251	688	136	132	251	60	49	983	.....	628	.....	.....	.....	.....
27	Nevada	5	78	15	16	35	12	8	.....	12	.....	7	16	23	12	.....	.....	.....	.....
28	New Hampshire	50	2,879	298	816	1,249	516	298	50	1,240	157	.....	766	9	359	.....	.....	.....	.....
29	New Jersey	60	15,515	988	4,717	7,527	2,283	926	952	6,483	850	.....	3,765	.....	1,433	62	.....	1,044	.....
30	New Mexico	11	272	13	168	41	50	9	50	18	23	4	118	23	27	.....	.....	.....	.....
31	New York	228	57,305	11,375	15,322	19,888	10,720	9,051	4,177	13,324	3,807	2,280	11,145	692	6,913	44	.....	5,872	.....
32	North Carolina	22	508	44	36	249	179	34	22	249	104	.....	14	.....	75	10	.....	.....	.....
33	North Dakota	13	306	.....	154	40	112	.....	145	40	106	.....	9	.....	6	.....	.....	.....	.....
34	Ohio	145	26,137	1,857	10,635	10,059	3,586	1,553	7,818	9,331	2,284	.....	2,814	110	1,302	304	3	618	.....
35	Oklahoma	8	677	55	276	275	71	55	237	259	20	.....	39	16	51	.....	.....	.....	.....
36	Oregon	33	1,963	387	580	927	89	385	117	911	7	.....	457	.....	82	2	6	16	.....
37	Pennsylvania	243	44,183	6,503	11,829	18,032	7,819	6,334	8,396	17,647	2,308	169	3,134	235	5,504	.....	299	150	7
38	Rhode Island	6	5,106	37	1,973	2,882	214	37	1,323	2,882	.....	.....	650	.....	214	.....	.....	.....	.....
39	South Carolina	16	1,006	6	535	114	351	5	.....	86	89	1	535	28	262	.....	.....	.....	.....
40	South Dakota	22	626	72	363	131	60	72	291	131	17	.....	72	.....	43	.....	.....	.....	.....
41	Tennessee	35	2,691	50	965	829	847	50	10	813	32	.....	954	16	815	.....	1	.....	.....
42	Texas	130	4,519	428	2,368	790	933	310	395	764	33	118	1,973	26	900	.....	.....	.....	.....
43	Utah	15	1,468	10	874	515	69	3	.....	515	.....	7	874	.....	69	.....	.....	.....	.....
44	Vermont	41	1,449	141	310	698	305	141	4	652	52	.....	294	41	258	.....	12	.....	.....
45	Virginia	27	752	34	285	224	209	33	7	224	56	.....	278	.....	153	1	.....	.....	.....
46	Washington	33	2,010	457	965	487	101	425	721	379	30	32	244	108	71	.....	.....	.....	.....
47	West Virginia	35	1,216	39	427	356	394	39	121	320	151	.....	291	36	243	.....	15	.....	.....
48	Wisconsin	124	6,702	672	2,475	1,992	1,563	671	1,703	1,951	755	1	737	41	808	.....	35	.....	.....
49	Wyoming	13	259	30	113	46	70	30	60	46	21	.....	53	.....	49	.....	.....	.....	.....
50	All other states[1]	4	3,044	359	1,428	1,141	116	265	817	1,141	112	.....	111	.....	4	94	500	.....	.....
51	Alaska and Hawaii	4	152	.....	126	15	11	.....	4	.....	.....	.....	122	15	11	.....	.....	.....	.....

[1] Includes states having less than 3 stations, in order that the operations of individual stations may not be disclosed. These stations are distributed as follows: Delaware, 2; District of Columbia, 2.

STATIONS, BY STATES AND TERRITORIES: 1902.

INCANDESCENT LIGHTING—NUMBER OF LAMPS IN SERVICE.									MOTOR SERVICE.			
Aggregate.	Total.		16-candlepower.		32-candlepower.		All other candlepower.		Stationary.		Railway car.	
	Commercial or other private.	Public.	Commercial or other private.	Public.	Commercial or other private.	Public.	Commercial or other private.	Public.	Number.	Horse-power.	Number of cars served.	
16,616,593	16,243,853	372,740	13,890,281	235,842	484,246	47,063	1,869,326	89,835	99,102	434,681	2,370	1
52,988	52,610	378	51,247	369	1,363	9	.....	.....	747	737	23	2
36,556	36,295	261	34,950	240	890	21	455	.....	432	714	.....	3
75,191	74,310	881	64,416	106	5,520	396	4,374	379	818	720	12	4
977,384	964,979	12,405	921,136	10,345	7,236	1,607	36,607	453	5,112	49,856	231	5
294,650	290,069	4,581	284,673	4,208	2,460	236	2,936	137	1,264	12,484	6	6
260,436	256,941	3,495	215,596	988	14,589	46	26,756	2,461	826	6,271	5	7
30,404	29,187	1,217	26,504	1,000	2,128	192	555	25	86	51	.....	8
34,636	32,467	2,169	32,019	1,858	375	158	73	153	47	2,123	2	9
32,229	32,131	98	27,464	80	895	16	3,772	2	163	205	.....	10
1,444,089	1,420,207	23,882	1,377,619	17,299	14,995	3,579	27,593	2,954	11,828	35,910	180	11
522,118	515,625	6,493	451,928	5,090	7,735	702	55,962	701	2,267	5,550	7	12
13,694	13,467	127	12,498	55	594	62	375	10	28	4	.....	13
343,346	335,331	8,015	291,356	2,359	13,615	3,651	30,360	2,005	1,037	4,163	11	14
120,112	118,368	1,744	99,671	1,188	3,771	214	14,926	392	1,384	1,864	.....	15
131,277	129,592	1,685	122,416	603	5,676	295	1,500	787	767	3,113	30	16
119,901	118,016	1,885	95,185	1,426	14,769	271	8,062	188	883	5,094	.....	17
204,332	199,370	4,962	193,582	2,506	2,086	761	3,702	1,695	525	6,437	.....	18
122,827	117,498	5,329	112,616	3,331	1,512	894	3,370	1,104	665	2,523	6	19
1,826,524	1,805,370	21,154	1,286,837	1,687	1,506	2,280	17,027	17,187	9,621	35,565	219	20
599,518	590,696	8,822	476,074	7,722	21,344	618	93,278	482	2,089	10,873	64	21
246,763	241,633	5,130	234,084	3,628	4,265	1,227	3,284	275	1,826	9,331	8	22
57,906	57,169	737	51,197	361	2,008	275	3,969	101	1,088	239	4	23
538,289	528,550	9,739	500,566	8,511	10,958	1,014	17,026	214	4,552	14,411	2	24
99,043	98,627	416	95,377	369	1,777	47	1,473	.....	141	1,397	6	25
128,736	125,829	2,907	108,850	2,384	3,246	318	13,733	205	589	2,253	.....	26
8,213	8,182	31	7,871	17	186	14	125	.....	13	180	.....	27
168,877	162,661	6,216	140,212	2,085	8,946	2,632	13,508	1,549	415	4,583	27	28
630,602	610,060	20,542	527,422	9,312	58,316	5,685	24,322	5,545	2,209	9,245	86	29
22,507	22,406	101	21,722	48	635	53	49	.....	75	100	.....	30
3,646,093	3,506,803	139,290	2,230,905	93,229	173,282	7,958	1,102,666	33,103	13,557	109,195	.....	31
23,704	22,811	893	22,089	782	550	110	172	1	161	770	.....	32
31,956	31,614	342	31,095	155	274	137	245	50	81	703	.....	33
762,626	745,288	17,338	720,162	15,520	13,298	980	11,828	888	5,585	21,657	131	34
20,349	20,311	38	18,233	38	1,370	.....	708	.....	402	343	.....	35
91,634	89,566	2,068	75,568	1,742	4,850	326	9,128	.....	403	4,020	70	36
1,729,660	1,709,161	20,499	1,431,129	14,081	41,867	2,849	236,165	3,619	14,128	30,586	919	37
194,688	187,311	7,377	150,549	282	3,125	2,431	33,637	4,664	989	6,236	10	38
35,548	31,729	3,819	31,229	3,819	500	.....	.....	.....	160	6,546	3	39
50,025	49,398	627	44,228	358	1,147	256	4,023	13	43	239	.....	40
156,914	154,597	2,317	149,657	1,509	1,434	398	3,506	410	1,218	3,335	73	41
285,657	281,188	4,469	264,630	3,617	8,416	571	8,142	281	8,099	4,547	85	42
91,130	89,791	1,339	88,954	564	613	727	224	48	295	5,868	.....	43
127,781	123,548	4,233	104,909	2,815	2,592	815	16,047	603	263	2,600	26	44
30,382	29,556	826	26,460	229	968	282	2,128	315	403	249	.....	45
72,359	71,638	721	61,349	581	3,306	118	6,983	22	254	2,723	42	46
75,510	74,623	887	70,272	192	2,281	422	2,070	273	136	291	10	47
375,271	366,468	8,803	336,869	7,110	9,423	1,337	20,176	356	513	5,430	32	48
22,082	21,805	277	17,896	194	1,609	73	2,300	10	1	1	.....	49
150,226	149,001	1,225	148,990	.....	.....	.....	11	1,225	764	3,396	40	50
33,877	31,627	2,250	31,627	250	.....	2,000	.....	.....	74	597	.....	51

TABLE 77.—CONDENSED STATEMENT: INCOME AND EXPENSES—MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902.

STATE OR TERRITORY.	Number of stations.	Gross income.	INCOME FROM SALE OF CURRENT.				Income from all other sources.	EXPENSES.				
			Total.	Arc lighting.	Incandescent lighting.	All other electric service.		Total.	Salaries and wages.	Cost of supplies, materials, and fuel.	Rents, taxes, insurance, and miscellaneous.	Interest on bonds.
United States	815	[1]$6,965,105	[1]$6,836,856	$3,389,245	$3,359,618	$87,993	$128,249	$5,245,967	$1,879,722	$2,422,291	$439,169	$504,805
Alabama	9	44,974	44,974	13,528	31,266	180	.....	34,244	9,960	17,022	2,000	5,262
Arkansas	8	43,039	41,931	18,977	22,654	300	1,108	38,753	13,405	19,802	3,026	2,520
California	10	128,973	122,051	33,963	74,856	13,212	6,922	90,444	32,294	42,807	7,491	7,852
Colorado	2	5,526	5,526	720	4,806	.....	.....	4,808	1,620	2,244	644	300
Connecticut	3	45,936	45,936	15,911	27,481	2,544	.....	33,698	10,705	16,985	2,383	3,625
Delaware	6	27,032	26,599	3,341	23,258	.....	433	25,262	8,019	11,380	1,948	3,915
Florida	5	133,133	133,133	34,062	93,695	5,376	.....	79,206	27,235	40,615	4,636	6,720
Georgia	19	131,770	128,504	54,052	74,452	.....	3,266	99,368	31,490	52,228	4,500	11,150
Idaho	1	5,652	5,652	840	4,812	.....	.....	4,380	2,970	1,060	.....	350
Illinois	82	1,179,003	1,177,679	916,930	260,481	268	1,324	720,826	288,037	345,641	68,256	18,892
Indiana	62	501,047	486,351	254,019	229,416	2,916	14,696	358,795	127,491	179,964	28,125	23,215
Iowa	38	248,074	233,541	47,172	184,383	1,986	14,533	188,789	62,823	95,430	16,610	13,926
Kansas	11	62,695	61,385	44,630	15,866	889	1,310	49,629	19,328	20,384	7,110	2,807
Kentucky	8	62,386	62,224	40,049	20,675	1,500	162	46,874	21,259	22,112	3,503	.....
Louisiana	10	77,391	75,516	18,942	54,561	2,013	1,875	64,033	24,906	29,989	4,545	4,593
Maine	2	14,100	14,100	9,600	4,500	.....	.....	7,315	4,764	1,341	1,210	.....
Maryland	5	34,145	33,945	27,309	6,566	70	200	30,821	11,442	13,581	2,118	3,680
Massachusetts	17	270,301	264,922	96,486	164,660	3,776	5,379	262,984	87,271	105,681	37,296	32,736
Michigan	81	758,098	718,694	386,396	324,638	7,660	39,404	582,573	218,668	239,299	45,357	79,249
Minnesota	70	410,705	410,354	106,406	301,278	2,670	351	335,683	106,905	175,906	22,391	30,481
Mississippi	18	121,146	115,319	32,436	81,224	1,659	5,827	94,884	29,427	49,025	4,152	12,280
Missouri	43	270,545	261,528	114,860	143,180	3,488	9,017	212,677	73,987	100,655	14,468	23,567
Montana	1	16,208	16,208	4,000	12,148	60	.....	11,788	3,204	6,174	1,390	1,020
Nebraska	11	60,918	60,918	20,620	39,857	441	.....	47,923	17,072	23,996	2,231	4,624
New Hampshire	1	3,250	3,250	.....	3,250	.....	.....	3,033	600	2,213	.....	220
New Jersey	4	42,653	42,653	11,200	31,368	85	.....	25,782	9,221	10,603	2,208	3,750
New York	28	223,037	222,750	119,106	93,753	9,891	287	186,992	66,891	84,686	18,430	16,985
North Carolina	16	95,726	95,726	44,421	51,125	180	.....	73,256	22,674	37,777	3,190	9,615
North Dakota	8	54,484	54,484	17,225	37,259	.....	.....	44,384	14,790	23,668	2,456	3,470
Ohio	88	701,699	694,728	339,026	347,672	8,030	6,971	569,843	207,536	252,133	35,003	75,171
Oklahoma	2	15,927	13,761	3,408	10,353	.....	2,166	10,373	4,320	4,431	1,122	500
Oregon	6	21,320	21,320	3,776	17,544	.....	.....	17,153	5,540	8,164	1,449	2,000
Pennsylvania	36	429,364	426,353	264,965	158,841	2,547	3,011	305,629	115,363	125,013	32,981	32,272
Rhode Island	1	8,777	8,769	5,134	3,635	.....	8	8,027	2,330	3,341	1,459	897
South Carolina	8	48,791	47,007	22,763	24,244	.....	1,784	46,071	14,557	23,291	2,595	5,628
South Dakota	6	28,754	28,754	11,957	16,797	.....	.....	22,600	7,520	12,891	929	1,260
Tennessee	19	84,293	83,493	34,108	48,985	400	800	67,813	23,839	31,884	3,309	8,781
Texas	7	116,990	116,990	49,875	61,685	5,430	.....	84,108	30,375	42,025	7,808	3,900
Utah	1	2,870	2,870	20	2,850	.....	.....	2,002	1,560	158	184	105
Vermont	11	52,113	46,550	2,825	38,405	5,320	5,563	35,637	14,520	4,129	6,729	10,259
Virginia	10	55,826	55,826	35,096	20,249	481	.....	42,878	16,190	17,471	4,322	4,895
Washington	7	148,208	147,380	43,609	99,150	4,621	828	145,468	39,987	70,333	16,098	19,050
West Virginia	6	56,739	56,739	51,270	5,469	.....	.....	36,513	17,882	13,655	2,616	2,360
Wisconsin	28	121,487	120,463	34,192	86,271	.....	1,024	92,668	29,745	41,109	10,891	10,923

[1] Includes estimated income from public lighting.

TABLE 78.—ANALYSIS OF INCOME—MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902.

STATE OR TERRITORY.	Number of stations.	Gross income.	INCOME FROM—											
			Arc lighting.			Incandescent lighting.			Motor service.	Electric railway service.	Electric heating.	Charging automobiles.	All other electric service.	All other sources.
			Total.	Commercial or other private.	Public.	Total.	Commercial or other private.	Public.						
United States ..	815	[1]$6,965,105	[1]$3,389,245	$240,166	[2]$3,149,079	[1]$3,359,618	$2,868,296	[2]$491,822	$70,540	$3,172	$58	$97	$14,126	$128,249
Alabama	9	44,974	13,528	1,418	12,110	31,266	30,640	626	180	.....	.....	.....	.....	.....
Arkansas	8	43,039	18,977	360	18,617	22,654	21,261	1,393	300	.....	.....	.....	.....	1,108
California	10	128,973	33,988	714	33,269	74,856	55,135	19,721	10,720	2,492	.....	.....	.....	6,922
Colorado	2	5,526	720	60	660	4,806	4,296	510	.....	.....	.....	.....	.....	.....
Connecticut	3	45,936	15,911	1,860	14,051	27,481	26,198	1,283	2,500	.....	.....	20	24	.....
Delaware	6	27,032	3,341	567	2,774	23,258	16,888	6,370	.....	.....	.....	.....	.....	433
Florida	5	133,133	34,062	10,740	23,322	93,695	87,565	6,130	5,376	.....	.....	.....	.....	.....
Georgia	19	131,770	54,052	908	53,144	74,452	68,614	5,838	.....	.....	.....	.....	.....	3,266
Idaho	1	5,652	840	.....	840	4,812	4,800	12	.....	.....	.....	.....	.....	.....
Illinois	82	1,179,093	916,930	5,244	911,686	260,481	188,388	72,093	268	.....	.....	.....	.....	1,324
Indiana	62	501,047	254,019	36,761	217,258	229,416	219,506	9,910	2,655	.....	.....	12	249	14,696
Iowa	88	248,074	47,172	14,259	32,913	184,383	156,145	28,238	1,986	.....	.....	.....	.....	14,533
Kansas	11	62,695	44,630	4,797	39,833	15,866	13,693	2,173	889	.....	.....	.....	.....	1,310
Kentucky	8	62,386	40,049	3,000	37,049	20,675	20,615	60	1,500	.....	.....	.....	.....	162
Louisiana	10	77,391	18,942	2,772	16,170	54,561	45,809	8,752	2,013	.....	.....	.....	.....	1,875
Maine	2	14,100	9,600	.....	9,600	4,500	.....	4,500	.....	.....	.....	.....	.....	.....
Maryland	5	34,145	27,309	900	26,409	6,566	5,146	1,420	70	.....	.....	.....	.....	200
Massachusetts	17	270,301	96,486	11,179	85,307	164,660	135,557	29,103	3,776	.....	.....	.....	.....	5,379
Michigan	81	758,098	386,396	29,343	357,053	324,638	277,911	46,727	7,660	.....	.....	.....	.....	39,404
Minnesota	70	410,705	106,406	22,228	84,178	301,278	280,200	21,078	2,570	.....	.....	.....	100	351
Mississippi	18	121,146	32,436	3,579	28,857	81,224	76,878	4,346	1,659	.....	.....	.....	.....	5,827
Missouri	43	270,545	114,860	8,025	106,835	143,180	112,570	30,610	2,808	680	.....	.....	.....	9,017
Montana	1	16,208	4,000	2,500	1,500	12,148	12,148	.....	60	.....	.....	.....	.....	.....
Nebraska	11	60,918	20,620	4,490	16,130	39,857	34,846	5,011	441	.....	.....	.....	.....	.....
New Hampshire	1	3,250	.....	.....	.....	3,250	1,750	1,500	.....	.....	.....	.....	.....	.....
New Jersey	4	42,653	11,200	425	10,775	31,368	18,768	12,600	20	.....	.....	65	.....	.....
New York	28	223,087	119,106	4,840	114,266	93,753	80,524	13,229	1,391	.....	.....	.....	8,500	287
North Carolina	16	95,726	44,421	6,424	37,997	51,125	43,353	7,772	180	.....	.....	.....	.....	.....
North Dakota	8	54,484	17,225	1,435	15,790	37,259	33,644	3,615	.....	.....	.....	.....	.....	.....
Ohio	88	701,699	339,026	29,731	309,295	347,672	331,794	15,878	5,525	.....	.....	.....	2,505	6,971
Oklahoma	2	15,927	3,408	624	2,784	10,353	9,993	360	.....	.....	.....	.....	.....	2,166
Oregon	6	21,320	3,776	336	3,440	17,544	14,498	3,046	.....	.....	.....	.....	.....	.....
Pennsylvania	36	429,364	264,965	5,930	259,035	158,841	80,273	78,568	1,088	.....	.....	.....	1,459	3,011
Rhode Island	1	8,777	5,134	.....	5,134	3,635	3,635	.....	.....	.....	.....	.....	.....	8
South Carolina	8	48,791	22,763	120	22,643	24,244	22,705	1,539	.....	.....	.....	.....	.....	1,784
South Dakota	6	28,754	11,957	625	11,332	16,797	15,121	1,676	.....	.....	.....	.....	.....	.....
Tennessee	19	84,293	34,108	2,010	32,098	48,985	40,300	8,685	.....	.....	.....	.....	400	800
Texas	7	116,990	49,875	1,630	48,245	61,685	49,364	12,321	5,430	.....	.....	.....	.....	.....
Utah	1	2,870	20	20	.....	2,850	2,270	580	.....	.....	.....	.....	.....	.....
Vermont	11	52,113	2,825	159	2,666	38,405	30,358	8,047	4,373	.....	58	.....	889	5,563
Virginia	10	55,826	35,096	784	34,312	20,249	18,212	2,037	481	.....	.....	.....	.....	.....
Washington	7	148,208	43,609	15,925	27,684	99,150	92,513	6,637	4,621	.....	.....	.....	.....	828
West Virginia	6	56,739	51,270	.....	51,270	5,469	5,004	465	.....	.....	.....	.....	.....	.....
Wisconsin	28	121,487	34,192	3,444	30,748	86,271	79,408	6,863	.....	.....	.....	.....	.....	1,024

[1] Includes estimated value from public lighting.

[2] Value estimated according to prevailing rates.

TABLE 79.—CHARACTER OF SERVICE, BONDS, COST OF CONSTRUCTION AND EQUIPMENT—MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902.

STATE OR TERRITORY.	Number of stations.	NUMBER OF STATIONS BY CHARACTER OF SERVICE.							BONDS.			COST OF CONSTRUCTION AND EQUIPMENT—	
		Arc lighting.		Incandescent lighting.		Motor power.		All other.	Authorized.	Outstanding.	Interest.	To date.	During the year.
		Commercial or other private.	Public.	Commercial or other private.	Public.	Stationary.	Electric railway.						
United States....	815	353	712	732	602	118	2	9	$12,625,482	$11,609,488	$504,805	$22,020,473	$1,741,834
Alabama	9	5	9	9	3	1	.....	.....	109,000	97,000	5,262	110,290	4,556
Arkansas	8	3	8	7	3	1	.....	.....	51,700	47,500	2,520	110,120	1,732
California	10	2	9	8	7	3	1	.....	191,000	161,150	7,852	415,478	30,571
Colorado	2	1	1	2	2	.....	.....	.....	5,000	5,000	300	14,940	1,515
Connecticut	3	2	3	3	3	.....	.....	1	97,500	97,500	3,625	135,332	1,082
Delaware	6	2	3	6	5	.....	.....	.....	97,000	97,000	3,915	88,562	2,300
Florida	5	1	5	5	5	1	.....	.....	134,500	134,500	6,720	277,421	37,797
Georgia	19	5	19	18	18	.....	.....	.....	241,000	227,000	11,150	351,202	65,186
Idaho	1	.....	1	1	1	.....	.....	.....	7,000	7,000	350	6,930	330
Illinois	82	16	66	65	52	5	.....	.....	504,365	487,365	18,892	3,727,566	201,148
Indiana	62	32	60	55	39	15	.....	3	766,500	743,656	23,215	1,507,989	142,072
Iowa	38	22	26	36	33	4	.....	.....	333,860	318,960	13,926	691,108	45,682
Kansas	11	8	10	8	9	2	.....	.....	64,500	64,500	2,807	196,716	5,187
Kentucky	8	1	7	6	2	2	.....	.....	.....	.....	.....	241,686	27,760
Louisiana	10	3	8	10	9	6	.....	.....	90,900	90,900	4,593	207,600	14,165
Maine	2	.....	1	.....	1	.....	.....	.....	.....	.....	.....	41,700	5,450
Maryland	5	1	4	3	2	1	.....	.....	96,500	96,500	3,680	120,339	390
Massachusetts	17	11	14	16	13	5	.....	.....	838,500	809,000	32,736	1,227,261	119,127
Michigan	81	47	76	74	64	11	.....	.....	2,064,600	1,833,850	79,249	2,989,688	243,484
Minnesota	70	38	65	70	55	6	.....	1	645,050	630,050	30,481	1,155,802	156,280
Mississippi	18	9	18	18	12	7	.....	.....	231,000	231,000	12,280	303,959	28,015
Missouri	43	20	38	40	32	14	1	.....	598,500	512,950	23,567	845,599	76,564
Montana	1	1	1	1	.....	1	.....	.....	17,000	17,000	1,020	32,000	2,050
Nebraska	11	6	9	11	11	2	.....	.....	83,400	81,400	4,624	153,984	12,799
New Hampshire	1	.....	.....	1	1	.....	.....	.....	5,500	5,500	220	9,800	251
New Jersey	4	2	2	4	4	1	.....	.....	90,000	90,000	3,750	198,465	5,882
New York	28	6	23	24	22	6	.....	.....	520,340	519,340	16,985	812,949	82,852
North Carolina	16	8	15	16	12	1	.....	.....	306,500	189,000	9,615	228,877	20,442
North Dakota	8	4	8	7	5	.....	.....	.....	64,000	64,000	3,470	103,455	15,015
Ohio	88	43	84	82	64	13	.....	.....	1,738,400	1,573,900	75,171	1,989,055	180,434
Oklahoma	2	2	2	2	2	.....	.....	1	15,000	10,000	500	30,338	6,011
Oregon	6	1	2	6	6	.....	.....	.....	32,567	32,567	2,000	49,088	2,432
Pennsylvania	36	14	33	27	25	4	.....	.....	817,500	801,600	32,272	1,146,264	42,492
Rhode Island	1	.....	1	1	.....	.....	.....	.....	20,000	20,000	897	22,919	.....
South Carolina	8	2	8	8	7	.....	.....	.....	99,300	99,300	5,628	130,153	9,188
South Dakota	6	2	6	4	4	.....	.....	.....	35,000	35,000	1,260	85,983	12,340
Tennessee	19	8	17	17	12	.....	.....	.....	318,500	303,500	8,781	362,372	9,707
Texas	7	2	7	4	6	1	.....	.....	97,000	85,000	3,900	216,021	25,115
Utah	1	1	.....	1	1	.....	.....	.....	5,000	1,000	105	9,499	860
Vermont	11	3	3	11	11	3	.....	3	303,000	257,000	10,259	352,449	17,008
Virginia	10	3	8	8	9	1	.....	.....	106,000	100,000	4,895	215,918	17,773
Washington	7	3	3	7	7	1	.....	.....	389,000	359,500	19,050	583,880	30,329
West Virginia	6	.....	6	4	3	.....	.....	.....	112,000	48,000	2,360	154,466	2,510
Wisconsin	28	13	23	26	20	.....	.....	.....	282,500	274,500	10,923	425,300	35,951

TABLE 80.—ANALYSIS OF SUPPLIES, MATERIALS, AND FUEL—

	STATE OR TERRITORY.	Number of stations.	Aggregate cost.	METERS.		MOTORS.		TRANSFORMERS.		INCANDESCENT LAMPS.		INCANDESCENT LAMP FITTINGS, SOCKETS, ETC.	CARBONS FOR ARC LAMPS.		GLOBES FOR ARC LAMPS.	
				Number.	Cost.	Number.	Cost.	Number.	Cost.	Number.	Cost.	Cost.	Number.	Cost.	Number.	Cost.
1	United States...	815	$2,422,291	1,893	$26,425	30	$897	5,445	$88,621	440,384	$81,025	$22,719	12,529,666	$150,598	56,094	$20,420
2	Alabama	9	17,022	.....	.....	3	37	9	471	1,450	263	25	30,900	443	599	208
3	Arkansas	8	19,802	.....	.....	.....	.....	5	121	1,575	334	90	70,200	1,147	210	57
4	California	10	42,807	16	281	.....	.....	10	521	9,273	1,590	1,071	69,507	1,484	174	134
5	Colorado	2	2,244	.....	.....	.....	.....	.....	.....	240	44	5	2,640	33	.....	.....
6	Connecticut	3	16,985	4	50	.....	.....	.....	.....	1,055	190	25	60,500	703	432	200
7	Delaware	6	11,380	.....	.....	.....	.....	.....	.....	760	127	30	3,000	30	55	20
8	Florida	5	40,615	.....	.....	.....	.....	2	400	3,215	842	.....	271,044	3,099	441	251
9	Georgia	19	52,228	111	1,713	.....	.....	42	1,706	9,450	1,679	1,031	188,890	1,987	782	319
10	Idaho	1	1,060	.....	.....	.....	.....	.....	.....	50	13	.....	800	40	100	50
11	Illinois	82	345,641	43	473	2	30	95	3,000	30,125	6,297	640	2,965,547	34,608	8,156	3,372
12	Indiana	62	179,964	50	624	7	53	156	3,891	37,180	6,751	2,142	910,878	10,043	4,217	1,456
13	Iowa	38	95,430	221	3,162	4	338	35	996	32,710	6,150	1,857	75,272	1,103	871	307
14	Kansas	11	20,384	1	19	.....	.....	8	225	5,874	1,113	423	68,650	2,317	575	248
15	Kentucky	8	22,112	25	675	.....	.....	16	687	9,700	1,476	85	95,600	1,540	768	242
16	Louisiana	10	29,989	2	33	.....	.....	22	721	2,018	607	255	19,204	392	1,029	434
17	Maine	2	1,341	.....	.....	.....	.....	.....	.....	500	150	10	24,000	600	96	72
18	Maryland	5	13,581	.....	.....	.....	.....	.....	.....	2,100	342	.....	95,334	1,308	810	143
19	Massachusetts	17	105,681	103	1,739	.....	.....	38	1,279	19,791	3,413	368	491,978	5,013	1,654	733
20	Michigan	81	239,299	54	737	12	389	106	3,431	58,896	10,749	3,794	1,932,780	19,365	11,868	3,640
21	Minnesota	70	175,906	163	2,090	.....	.....	4,030	2,683	36,951	6,588	1,128	194,212	3,119	1,719	708
22	Mississippi	18	49,025	9	127	.....	.....	32	525	10,558	1,837	493	74,602	1,063	1,525	349
23	Missouri	43	100,655	182	2,315	.....	.....	31	723	17,783	3,505	480	413,607	4,140	2,132	732
24	Montana	1	6,174	.....	.....	.....	.....	14	300	3,000	600	100	10,000	125	20	15
25	Nebraska	11	23,996	.....	.....	.....	.....	99	206	6,660	1,177	322	31,170	602	430	116
26	New Hampshire	1	2,213	.....	.....	.....	.....	.....	.....	100	33	2	.....	.....	.....	.....
27	New Jersey	4	10,603	5	85	.....	.....	4	152	700	281	40	30,000	309	216	35
28	New York	28	84,686	133	2,041	.....	.....	56	1,754	9,425	1,726	100	482,472	6,239	2,671	977
29	North Carolina	16	37,777	53	963	.....	.....	24	906	11,949	2,062	345	55,844	964	883	268
30	North Dakota	8	23,668	30	498	.....	.....	.....	.....	2,335	570	157	15,150	340	471	172
31	Ohio	88	252,133	409	5,701	2	50	210	6,449	49,969	8,935	4,573	1,518,690	16,532	4,771	1,750
32	Oklahoma	2	4,431	.....	.....	.....	.....	.....	.....	1,800	288	41	4,000	118	60	21
33	Oregon	6	8,164	.....	.....	.....	.....	.....	.....	2,300	385	20	3,886	55	14	5
34	Pennsylvania	36	125,013	49	537	.....	.....	37	1,716	24,625	3,884	1,145	1,364,512	16,097	4,251	1,733
35	Rhode Island	1	3,341	14	147	.....	.....	12	256	610	122	.....	10,000	109	30	10
36	South Carolina	8	23,291	46	612	.....	.....	12	870	3,139	592	377	97,564	1,096	434	208
37	South Dakota	6	12,891	.....	.....	.....	.....	.....	.....	890	146	20	7,000	160	150	49
38	Tennessee	19	31,884	35	501	.....	.....	31	835	6,042	1,123	240	42,100	880	1,318	456
39	Texas	7	42,025	.....	.....	.....	.....	52	600	6,633	1,468	135	247,225	2,214	594	184
40	Utah	1	153	.....	.....	.....	.....	.....	.....	167	30	.....	.....	.....	.....	.....
41	Vermont	11	4,129	16	237	.....	.....	26	932	1,688	405	108	10,109	181	95	42
42	Virginia	10	17,471	6	90	.....	.....	1	40	1,373	304	39	115,062	1,605	235	113
43	Washington	7	70,333	72	313	.....	.....	205	1,527	4,250	838	480	93,000	3,474	413	324
44	West Virginia	6	13,655	5	75	.....	.....	5	150	550	95	210	252,333	4,260	129	31
45	Wisconsin	28	41,109	36	587	.....	.....	20	548	10,875	1,881	313	80,454	1,641	696	236

MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902.

ARC LAMP REPAIRS.	POLES OR OTHER SUPPORTS.	WIRE AND CABLE.	MILL SUPPLIES (OIL, WASTE, ETC.).	ALL OTHER MATERIALS.	POWER PURCHASED.	FREIGHT PAID, NOT INCLUDED IN OTHER ITEMS.	FUEL.						
							Total cost.	Coal.		Crude petroleum.	Natural gas.	Artificial gas.	All other fuel.
Cost.	Cost.	Cost.	Cost.	Cost.	Cost.			Number of tons.	Cost.	Cost.	Cost.	Cost.	Cost.	
$32,306	$26,970	$71,535	$94,886	$105,648	$123,566	$180,851	$1,445,824	568,460	$1,193,731	$21,702	$33,809	$8,519	$88,063	1
350	1,414	290	1,109	306	.....	245	11,861	2,210	5,248	.....	.....	.....	6,613	2
130	168	1,027	1,007	541	.....	1,899	13,281	4,701	11,456	.....	.....	.....	1,825	3
275	777	1,609	1,608	3,048	11,642	192	18,575	.....	.....	13,667	.....	.....	4,908	4
2	14	5	134	27	.....	.....	1,980	1,200	1,980	.....	.....	.....	.....	5
118	.....	245	269	137	3,600	.....	11,448	3,046	11,448	.....	.....	.....	.....	6
35	117	70	693	136	.....	4,472	5,650	3,550	5,650	.....	.....	.....	.....	7
1,353	13	2,063	1,071	2,049	.....	.....	29,474	.....	.....	.....	.....	.....	29,474	8
377	1,620	1,421	2,037	2,021	2,599	9,062	24,656	5,483	6,499	.....	.....	.....	18,157	9
.....	.....	.....	57	.....	900	.....	.....	.....	.....	.....	.....	.....	.....	10
9,398	3,097	7,535	13,765	13,027	12,480	2,128	235,791	111,974	227,745	.....	.....	6,792	1,254	11
1,729	2,226	6,054	7,471	8,568	4,265	27,328	97,363	47,939	77,962	.....	19,170	3	228	12
367	577	2,191	3,548	4,946	.....	3,204	66,684	37,570	65,647	.....	.....	.....	1,037	13
255	201	662	631	1,195	2,160	2,545	8,390	3,549	6,917	.....	1,473	.....	.....	14
438	244	968	1,175	1,384	.....	1,517	11,681	8,599	10,470	.....	.....	.....	1,211	15
94	640	290	1,617	1,941	.....	7,324	15,641	1,188	4,278	3,863	.....	.....	7,500	16
.....	65	169	65	160	.....	50	.....	.....	.....	.....	.....	.....	.....	17
436	75	550	883	1,029	.....	604	8,261	3,176	8,259	.....	.....	.....	2	18
1,001	3,221	4,752	4,018	4,513	19,110	.....	56,521	13,018	54,712	.....	.....	.....	1,809	19
3,090	3,406	7,693	8,985	12,154	2,900	13,984	145,032	51,974	124,653	.....	.....	1,724	18,655	20
888	911	1,748	6,220	4,775	2,604	29,807	112,637	24,491	77,115	.....	.....	.....	35,522	21
801	1,308	1,897	1,986	1,639	5,194	4,547	27,739	9,437	20,434	.....	.....	.....	7,305	22
1,104	722	2,143	4,603	5,965	.....	2,124	72,099	36,987	66,661	.....	.....	.....	5,438	23
25	.....	.....	480	915	.....	350	3,264	1,400	3,264	.....	.....	.....	.....	24
39	75	517	1,239	566	.....	4,073	15,064	5,623	15,064	.....	.....	.....	.....	25
.....	.....	77	.....	.....	2,100	1	.....	.....	.....	.....	.....	.....	.....	26
40	59	153	764	713	.....	.....	7,972	2,521	7,972	.....	.....	.....	.....	27
1,757	426	2,823	2,841	3,164	.....	4,698	56,140	19,701	56,092	.....	.....	.....	48	28
392	214	137	1,335	1,087	3,594	4,698	20,792	4,080	10,536	.....	.....	.....	10,256	29
201	329	718	590	1,360	.....	160	18,578	2,435	13,548	.....	.....	.....	5,025	30
3,408	733	11,252	8,961	10,568	.....	23,320	149,901	78,815	141,249	450	7,742	.....	460	31
16	30	460	170	80	.....	.....	3,207	1,005	3,207	.....	.....	.....	.....	32
15	136	108	180	58	470	15	6,717	.....	.....	.....	.....	.....	6,717	33
1,814	1,256	1,962	5,356	8,876	.....	6,621	74,016	44,677	68,642	.....	4,624	.....	750	34
129	30	7	95	389	.....	509	1,588	417	1,467	.....	.....	.....	71	35
380	306	330	1,108	823	.....	2,115	14,474	2,498	6,753	.....	.....	.....	7,721	36
30	6	6	641	24	.....	6,185	5,624	2,269	5,124	.....	500	.....	.....	37
168	94	1,111	1,907	918	400	721	22,530	11,357	20,696	.....	.....	.....	1,834	38
1,082	1,141	940	2,197	2,079	.....	11,700	18,335	4,237	13,135	3,722	.....	.....	1,478	39
.....	31	.....	31	61	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
65	108	15	328	491	.....	70	1,152	218	1,122	.....	.....	.....	30	41
201	276	196	885	395	6	3,310	10,011	4,313	9,640	.....	.....	.....	371	42
218	830	7,011	426	2,965	44,392	105	7,410	1,930	4,810	.....	.....	.....	2,600	43
372	1	51	697	6	.....	10	7,697	5,630	7,397	.....	300	.....	.....	44
263	73	279	1,758	529	5,150	1,208	26,643	5,242	16,879	.....	.....	.....	9,764	45

TABLE 81.—AVERAGE NUMBER OF EMPLOYEES AND TOTAL SALARIES

	STATE OR TERRITORY.	Number of stations.	SALARIED OFFICIALS AND CLERKS.								WAGE-EARNERS.			
			Total.		General officers.		Other officers, managers, superintendents, etc.		Clerks.		Total.		Foremen.	
			Number.	Salaries.	Number.	Salaries.	Number.	Salaries.	Number.	Salaries.	Average number.	Wages.	Average number.	Wages.
1	United States	815	950	$457,381	171	$36,051	518	$356,929	261	$64,401	2,467	$1,422,341	57	$42,766
2	Alabama	9	6	3,835	.....	.....	6	3,835	.....	.....	18	6,125	.....	.....
3	Arkansas	8	6	4,544	.....	.....	6	4,544	.....	.....	12	8,861	.....	.....
4	California	10	16	9,818	.....	.....	7	6,592	9	3,226	33	22,476	2	1,860
5	Colorado	2	.....	.....	.....	.....	.....	.....	.....	.....	3	1,620	.....	.....
6	Connecticut	3	5	3,835	2	435	2	3,250	1	150	10	6,870	.....	.....
7	Delaware	6	14	2,487	10	600	3	1,797	1	90	15	5,532	.....	.....
8	Florida	5	8	6,685	.....	.....	4	3,085	4	3,600	34	20,550	.....	.....
9	Georgia	19	20	11,267	.....	.....	15	10,390	5	877	57	20,223	1	300
10	Idaho	1	1	450	.....	.....	.....	.....	1	450	3	2,520	.....	.....
11	Illinois	82	55	36,245	3	1,917	38	31,009	14	3,319	359	251,792	12	10,180
12	Indiana	62	62	38,643	6	488	45	30,883	11	2,272	172	98,848	3	1,530
13	Iowa	38	38	16,116	1	120	19	12,760	18	3,236	89	46,707	1	720
14	Kansas	11	10	4,390	.....	.....	7	4,210	3	180	26	14,988	1	720
15	Kentucky	8	8	4,793	.....	.....	6	4,294	2	499	31	16,466	1	600
16	Louisiana	10	14	9,081	6	5,680	3	2,179	5	1,222	32	15,825	1	900
17	Maine	2	1	832	.....	.....	1	832	.....	.....	6	3,932	.....	.....
18	Maryland	5	5	1,832	.....	.....	2	1,560	3	272	21	9,610	.....	.....
19	Massachusetts	17	39	23,029	12	1,780	19	17,699	8	3,550	91	64,242	2	1,694
20	Michigan	81	108	55,112	14	8,848	58	37,817	36	8,447	290	163,556	9	5,973
21	Minnesota	70	50	29,275	.....	.....	30	24,766	20	4,509	127	77,630	1	1,200
22	Mississippi	18	15	11,265	1	960	9	8,668	5	1,637	34	18,162	2	1,980
23	Missouri	43	36	19,307	3	150	26	17,826	7	1,331	97	54,680	5	3,745
24	Montana	1	3	1,476	.....	.....	1	900	2	576	3	1,728	.....	.....
25	Nebraska	11	11	5,652	1	900	7	4,012	3	740	26	11,420	.....	.....
26	New Hampshire	1	.....	.....	.....	.....	.....	.....	.....	.....	1	600	.....	.....
27	New Jersey	4	4	1,735	1	175	1	300	2	1,260	12	7,486	.....	.....
28	New York	28	28	12,756	.....	.....	16	10,291	12	2,465	97	54,135	1	960
29	North Carolina	16	15	9,070	1	120	12	8,270	2	680	40	13,604	.....	.....
30	North Dakota	8	10	6,110	.....	.....	6	5,060	4	1,050	14	8,680	.....	.....
31	Ohio	88	181	53,250	58	5,852	73	38,120	50	9,278	275	154,286	1	420
32	Oklahoma	2	2	1,020	.....	.....	1	600	1	420	5	3,300	.....	.....
33	Oregon	6	4	2,960	.....	.....	4	2,960	.....	.....	5	2,580	1	720
34	Pennsylvania	36	46	24,141	13	3,248	24	18,076	9	2,817	140	91,222	1	1,200
35	Rhode Island	1	2	1,090	1	250	1	840	.....	.....	2	1,240	.....	.....
36	South Carolina	8	13	5,025	3	360	7	4,040	3	625	31	9,582	1	405
37	South Dakota	6	4	3,150	.....	.....	3	2,250	1	900	9	4,370	.....	.....
38	Tennessee	19	26	7,481	9	486	14	6,720	3	275	47	16,358	2	754
39	Texas	7	8	4,280	1	300	4	2,280	3	1,700	39	26,095	1	1,200
40	Utah	1	1	960	.....	.....	1	960	.....	.....	1	600	.....	.....
41	Vermont	11	19	5,099	10	768	7	4,240	2	91	19	9,421	1	415
42	Virginia	10	20	3,866	10	1,039	6	2,555	4	272	27	12,324	1	840
43	Washington	7	14	10,000	2	1,350	8	6,670	4	1,980	42	29,987	3	2,700
44	West Virginia	6	2	155	.....	.....	1	55	1	100	28	17,727	2	1,450
45	Wisconsin	28	20	10,264	3	225	15	9,734	2	305	44	19,481	1	300

AND WAGES—MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902.

WAGE-EARNERS—continued.																
Inspectors.		Engineers.		Firemen.		Dynamo and switchboard men.		Linemen.		Mechanics.		Lamp trimmers.		All other employees.		
Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	Average number.	Wages.	
25	$17,921	844	$538,743	505	$246,316	106	$65,611	349	$200,572	48	$27,661	319	$194,416	214	$88,335	1
.....	.....	7	3,036	6	1,717	.....	.....	2	552	.....	.....	1	396	2	424	2
1	870	5	3,735	3	1,998	1	1,020	1	792	.....	.....	.....	.....	1	446	3
1	150	12	8,930	3	1,680	7	4,770	5	3,322	.....	.....	2	1,620	1	144	4
.....	.....	2	1,500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	120	5
1	720	3	2,616	2	1,200	.....	.....	1	600	.....	.....	1	600	2	1,134	6
.....	.....	11	4,395	4	1,137	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
1	900	8	5,437	6	2,705	3	1,800	6	3,840	1	1,200	4	2,640	5	2,028	8
.....	.....	20	9,006	14	3,687	1	300	13	4,778	.....	.....	6	1,822	2	330	9
.....	.....	1	1,200	.....	.....	1	720	.....	.....	.....	.....	.....	.....	1	600	10
4	3,640	100	71,996	76	44,880	13	11,060	28	20,376	11	9,059	83	62,336	32	18,265	11
1	780	67	39,621	30	15,064	1	468	34	17,539	1	1,020	23	12,584	12	5,242	12
.....	.....	40	24,358	31	13,771	.....	.....	13	6,006	.....	.....	.....	.....	4	1,852	13
.....	.....	10	5,405	4	1,980	1	900	3	1,800	.....	.....	6	3,983	1	150	14
.....	.....	10	6,907	10	4,359	1	480	2	760	.....	.....	6	3,240	1	120	15
.....	.....	11	6,335	9	3,285	1	900	4	2,740	.....	.....	1	120	5	1,545	16
1	728	.....	.....	.....	.....	1	500	.....	.....	.....	.....	4	2,704	.....	.....	17
.....	.....	7	3,765	5	1,610	.....	.....	3	1,750	.....	.....	4	1,920	2	565	18
.....	.....	25	21,595	22	15,044	4	3,550	20	12,184	3	1,620	12	7,199	3	1,356	19
2	2,160	85	58,270	37	20,849	23	13,074	47	26,934	16	4,580	39	25,205	32	11,561	20
.....	.....	70	48,604	30	13,706	1	600	14	8,300	.....	.....	3	1,680	8	3,540	21
.....	.....	10	7,170	11	4,763	.....	.....	6	2,637	.....	.....	3	930	2	682	22
2	1,500	34	21,027	26	12,077	1	720	11	5,660	1	720	10	6,139	7	3,092	23
.....	.....	1	648	1	540	.....	.....	1	540	.....	.....	.....	.....	.....	.....	24
.....	.....	7	3,464	8	3,146	2	1,200	8	3,130	.....	.....	1	480	.....	.....	25
.....	.....	.....	.....	.....	.....	1	600	.....	.....	.....	.....	.....	.....	.....	.....	26
.....	.....	4	2,817	4	2,168	.....	.....	3	1,877	.....	.....	1	624	.....	.....	27
1	450	31	20,584	24	10,248	5	3,030	14	8,839	.....	.....	12	7,118	9	2,906	28
.....	.....	13	4,990	9	3,010	2	1,020	9	3,020	.....	.....	3	660	4	904	29
.....	.....	8	5,500	4	1,985	1	475	.....	.....	.....	.....	1	720	.....	.....	30
2	949	122	78,558	56	27,543	.....	.....	29	17,180	4	2,460	39	20,611	22	6,570	31
.....	.....	2	1,380	1	540	.....	.....	2	1,380	.....	.....	.....	.....	.....	.....	32
.....	.....	2	900	1	660	.....	.....	.....	.....	.....	.....	.....	.....	1	300	33
4	3,274	40	26,464	23	13,735	7	4,811	19	12,842	5	4,342	23	13,864	18	10,690	34
.....	.....	1	720	.....	.....	.....	.....	.....	.....	.....	.....	1	520	.....	.....	35
.....	.....	8	3,580	8	1,911	1	480	6	1,710	.....	.....	5	1,124	2	322	36
.....	.....	6	3,184	1	304	.....	.....	2	882	.....	.....	.....	.....	.....	.....	37
2	360	14	7,817	8	2,690	5	1,652	3	1,020	3	370	4	805	6	890	38
2	1,440	9	5,860	6	2,900	2	1,080	8	6,540	2	1,440	3	2,280	6	3,355	39
.....	.....	.....	.....	.....	.....	1	600	.....	.....	.....	.....	.....	.....	.....	.....	40
.....	.....	2	1,369	.....	.....	11	5,301	3	1,544	.....	.....	1	480	1	312	41
.....	.....	9	4,914	6	1,850	2	1,080	6	2,640	.....	.....	2	792	1	208	42
.....	.....	3	2,151	3	2,112	.....	.....	17	14,400	1	900	4	3,120	11	4,604	43
.....	.....	7	4,235	2	1,477	2	1,440	.....	.....	.....	.....	10	5,860	5	3,265	44
.....	.....	17	9,705	11	3,985	4	1,980	6	2,458	.....	.....	1	240	4	813	45

TABLE 82.—ANALYSIS OF MISCELLANEOUS EXPENSES—MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902.

STATE OR TERRITORY.	Number of stations.	Total expenses.	Rent of stations, supports, conduits, etc.	Rent of offices.	Taxes.	Injuries and damages.	Insurance.	Ordinary repairs of buildings and machinery.	All other expenses.
United States	815	$439,169	$10,187	$4,561	$10,120	$1,759	$65,641	$221,530	$125,371
Alabama	9	2,000	.....	.....	.....	.....	158	1,530	312
Arkansas	8	3,026	.....	.....	.....	.....	728	1,097	1,201
California	10	7,491	.....	.....	.....	.....	1,306	3,693	2,492
Colorado	2	644	.....	.....	.....	.....	113	505	26
Connecticut	3	2,383	.....	60	.....	.....	523	496	1,304
Delaware	6	1,948	.....	.....	51	.....	212	1,136	549
Florida	5	4,636	.....	.....	.....	.....	1,521	1,934	1,181
Georgia	19	4,500	200	60	182	150	670	2,386	852
Idaho	1	.....	.....	.....	.....	.....	.....	.....	.....
Illinois	82	68,256	3,255	348	171	.....	5,388	50,711	8,433
Indiana	62	28,125	860	400	275	508	5,579	12,761	7,747
Iowa	38	16,610	1,550	.....	.....	.....	2,421	8,894	3,745
Kansas	11	7,110	53	5	100	.....	756	1,230	4,966
Kentucky	8	3,503	.....	200	445	.....	782	1,616	460
Louisiana	10	4,545	.....	.....	.....	42	670	2,174	1,659
Maine	2	1,210	.....	.....	.....	.....	.....	575	635
Maryland	5	2,118	.....	.....	.....	75	236	1,270	537
Massachusetts	17	37,296	35	335	222	.....	6,582	15,173	14,949
Michigan	81	45,357	223	325	2,516	89	4,885	28,370	8,949
Minnesota	70	22,391	96	870	2,727	.....	4,370	7,088	7,290
Mississippi	18	4,152	.....	90	.....	.....	940	2,132	990
Missouri	43	14,468	87	111	39	250	3,553	7,904	2,524
Montana	1	1,390	.....	.....	.....	.....	370	1,000	20
Nebraska	11	2,231	120	150	.....	.....	504	545	912
New Hampshire	1	.....	.....	.....	.....	.....	.....	.....	.....
New Jersey	4	2,208	75	100	.....	.....	296	767	970
New York	28	18,430	6	134	64	100	3,069	9,408	5,629
North Carolina	16	3,190	200	160	300	.....	915	1,082	533
North Dakota	8	2,456	.....	.....	285	.....	708	790	673
Ohio	88	35,008	435	519	158	350	6,187	19,578	7,776
Oklahoma	2	1,122	.....	90	.....	.....	198	350	480
Oregon	6	1,449	10	.....	.....	.....	166	476	797
Pennsylvania	36	32,981	1,470	50	1,021	.....	3,811	18,787	8,392
Rhode Island	1	1,459	.....	.....	120	.....	287	41	1,011
South Carolina	8	2,596	.....	16	30	75	1,250	848	376
South Dakota	6	929	.....	.....	.....	.....	539	270	120
Tennessee	19	3,309	.....	54	.....	.....	1,124	985	1,196
Texas	7	7,808	.....	10	.....	.....	865	5,785	1,148
Utah	1	184	.....	24	.....	.....	.....	107	58
Vermont	11	6,729	.....	.....	407	.....	1,002	1,369	3,951
Virginia	10	4,322	12	378	1,007	.....	924	1,672	329
Washington	7	16,098	20	72	.....	.....	722	172	15,112
West Virginia	6	2,616	50	.....	.....	.....	50	2,475	41
Wisconsin	28	10,891	1,430	.....	.....	125	1,796	2,498	5,042

TABLE 83.—ELECTRIC LINE CONSTRUCTION—MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902.

STATE OR TERRITORY.	Number of stations.	AGGREGATE, MILES.		LIGHTING AND STATIONARY MOTOR SERVICE, MILES.								ELECTRIC RAILWAY CAR SERVICE OWNED BY LIGHTING COMPANIES, MILES.	
				Total.		Underground.		Overhead.		Submarine.			
		Mains.	Feeders.	Mains.	Feeders.	Mains.	Feeders.	Mains.	Feeders.	Mains.	Feeders.	Mains.	Feeders.
United States	815	13,910.68	1,428.23	13,910.68	1,428.23	439.16	14.53	13,470.63	1,410.84	0.89	2.86	.....	.....
Alabama	9	43.50	5.89	43.50	5.89	.....	.....	43.50	5.89	.....	.....	.....	.....
Arkansas	8	97.75	.....	97.75	.....	.....	.....	97.75	.....	.....	.....	.....	.....
California	10	258.00	23.25	258.00	23.25	.....	.....	258.00	23.25	.....	.....	.....	.....
Colorado	2	5.50	.....	5.50	.....	.....	.....	5.50	.....	.....	.....	.....	.....
Connecticut	3	64.55	28.02	64.55	28.02	.....	.....	64.30	28.02	0.25	.....	.....	.....
Delaware	6	35.80	26.70	35.80	26.70	.....	.....	35.80	26.70	.....	.....	.....	.....
Florida	5	131.50	.....	131.50	.....	.....	.....	131.50	.....	.....	.....	.....	.....
Georgia	19	249.00	5.00	249.00	5.00	.....	.....	249.00	5.00	.....	.....	.....	.....
Idaho	1	4.00	.....	4.00	.....	.....	.....	4.00	.....	.....	.....	.....	.....
Illinois	82	1,990.75	104.77	1,990.75	104.77	367.50	6.03	1,623.25	98.74	.....	.....	.....	.....
Indiana	62	845.60	54.07	845.60	54.07	.....	.....	845.60	54.07	.....	.....	.....	.....
Iowa	38	517.15	83.28	517.15	83.28	.....	.....	517.15	83.28	.....	.....	.....	.....
Kansas	11	162.00	4.00	162.00	4.00	.....	.....	162.00	4.00	.....	.....	.....	.....
Kentucky	8	197.00	19.00	197.00	19.00	.....	.....	197.00	19.00	.....	.....	.....	.....
Louisiana	10	75.81	18.67	75.81	18.67	.....	.....	75.81	18.67	.....	.....	.....	.....
Maine	2	44.00	.....	44.00	.....	.....	.....	44.00	.....	.....	.....	.....	.....
Maryland	5	132.00	8.00	132.00	8.00	.....	.....	132.00	8.00	.....	.....	.....	.....
Massachusetts	17	1,065.03	6.00	1,065.03	6.00	1.00	.....	1,064.03	6.00	.....	.....	.....	.....
Michigan	81	1,980.74	140.34	1,980.74	140.34	49.16	7.50	1,931.19	130.09	0.39	2.75	.....	.....
Minnesota	70	426.00	83.00	426.00	83.00	.....	.....	426.00	83.00	.....	.....	.....	.....
Mississippi	18	213.00	18.00	213.00	18.00	.....	.....	213.00	18.00	.....	.....	.....	.....
Missouri	43	696.79	69.50	696.79	69.50	.....	.....	696.79	69.50	.....	.....	.....	.....
Montana	1	8.00	4.00	8.00	4.00	.....	.....	8.00	4.00	.....	.....	.....	.....
Nebraska	11	94.90	3.75	94.90	3.75	.....	.....	94.90	3.75	.....	.....	.....	.....
New Hampshire	1	5.00	0.75	5.00	0.75	.....	.....	5.00	0.75	.....	.....	.....	.....
New Jersey	4	131.00	25.00	131.00	25.00	.....	.....	131.00	25.00	.....	.....	.....	.....
New York	28	698.75	73.50	698.75	73.50	20.00	.....	678.75	73.50	.....	.....	.....	.....
North Carolina	16	167.00	18.50	167.00	18.50	.....	.....	167.00	18.50	.....	.....	.....	.....
North Dakota	8	35.00	12.00	35.00	12.00	.....	.....	35.00	12.00	.....	.....	.....	.....
Ohio	88	1,405.68	144.75	1,405.68	144.75	.....	.....	1,405.68	144.75	.....	.....	.....	.....
Oklahoma	2	38.00	14.00	38.00	14.00	.....	.....	38.00	14.00	.....	.....	.....	.....
Oregon	6	45.40	18.44	45.40	18.44	.....	.....	45.40	18.44	.....	.....	.....	.....
Pennsylvania	36	675.10	120.75	675.10	120.75	.....	.....	675.10	120.75	.....	.....	.....	.....
Rhode Island	1	9.50	1.50	9.50	1.50	.....	.....	9.50	1.50	.....	.....	.....	.....
South Carolina	8	90.00	.....	90.00	.....	.....	.....	90.00	.....	.....	.....	.....	.....
South Dakota	6	28.00	4.00	28.00	4.00	.....	.....	28.00	4.00	.....	.....	.....	.....
Tennessee	19	316.30	19.00	316.30	19.00	.....	.....	316.30	19.00	.....	.....	.....	.....
Texas	7	188.00	5.00	188.00	5.00	.....	.....	188.00	5.00	.....	.....	.....	.....
Utah	1	10.50	1.50	10.50	1.50	.....	.....	10.50	1.50	.....	.....	.....	.....
Vermont	11	247.89	133.00	247.89	133.00	.....	.....	247.89	133.00	.....	.....	.....	.....
Virginia	10	81.38	44.74	81.38	44.74	.....	.....	81.38	44.74	.....	.....	.....	.....
Washington	7	129.81	42.04	129.81	42.04	1.50	1.00	128.31	41.04	.....	.....	.....	.....
West Virginia	6	86.25	3.00	86.25	3.00	.....	.....	86.25	3.00	.....	.....	.....	.....
Wisconsin	28	183.75	41.52	183.75	41.52	.....	.....	183.50	41.41	0.25	0.11	.....	.....

TABLE 84.—POWER AND GENERATING EQUIPMENT—

	STATE OR TERRITORY.	Number of stations.	STEAM ENGINES.								WATER WHEELS.							
			Total.		500 horsepower and under.		Over 500 and under 1,000 horsepower.		1,000 horsepower and over.		Total.		500 horsepower and under.		Over 500 and under 1,000 horsepower.		1,000 horsepower and over.	
			Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
1	United States	815	1,060	147,018	1,044	133,918	12	8,900	4	4,200	82	11,218	80	9,578	1	640	1	1,000
2	Alabama	9	9	935	9	935												
3	Arkansas	8	10	1,090	10	1,090												
4	California	10	11	1,660	11	1,660					3	450	3	450				
5	Colorado	2	2	120	2	120												
6	Connecticut	8	7	900	7	900												
7	Delaware	6	10	812	10	812												
8	Florida	5	8	1,885	7	1,135	1	750										
9	Georgia	19	19	2,556	19	2,556					2	132	2	132				
10	Idaho	1																
11	Illinois	82	116	21,085	106	12,385	6	4,500	4	4,200								
12	Indiana	62	82	12,404	81	11,754	1	650			6	505	6	505				
13	Iowa	38	46	5,876	46	5,876												
14	Kansas	11	13	1,478	13	1,478					1	60	1	60				
15	Kentucky	8	13	1,880	13	1,880												
16	Louisiana	10	16	1,380	16	1,380												
17	Maine	2									2	375	2	375				
18	Maryland	5	6	960	6	960												
19	Massachusetts	17	34	6,130	34	6,130					2	125	2	125				
20	Michigan	81	106	16,331	105	15,431	1	900			19	3,170	18	2,170			1	1,000
21	Minnesota	70	88	8,823	88	8,823					7	915	7	915				
22	Mississippi	18	23	2,885	23	2,885												
23	Missouri	43	54	6,866	54	6,866												
24	Montana	1	1	250	1	250												
25	Nebraska	11	12	1,431	12	1,431												
26	New Hampshire	1	1	150	1	150												
27	New Jersey	4	6	1,085	6	1,085												
28	New York	28	41	5,480	41	5,480					5	514	5	514				
29	North Carolina	16	17	1,890	17	1,890					2	140	2	140				
30	North Dakota	8	9	960	9	960												
31	Ohio	88	127	17,636	127	17,636					4	350	4	350				
32	Oklahoma	2	2	362	2	362												
33	Oregon	6	5	236	5	236					2	77	2	77				
34	Pennsylvania	36	59	7,580	59	7,580					2	285	2	285				
35	Rhode Island	1	1	100	1	100												
36	South Carolina	8	12	1,260	12	1,260												
37	South Dakota	6	6	630	6	630												
38	Tennessee	19	22	3,591	20	2,091	2	1,500			3	180	3	180				
39	Texas	7	11	2,245	10	1,645	1	600										
40	Utah	1									1	125	1	125				
41	Vermont	11	2	240	2	240					16	3,221	15	2,581	1	640		
42	Virginia	10	12	1,010	12	1,010					1	180	1	180				
43	Washington	7	6	590	6	590												
44	West Virginia	6	7	1,451	7	1,451												
45	Wisconsin	28	28	2,785	28	2,785					4	414	4	414				

MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902.

GAS ENGINES.		AUXILIARY STEAM ENGINES.		DYNAMOS.								BOOSTERS.		ROTARY CONVERTERS.		STORAGE BATTERY CELLS IN MAIN PLANTS.		
				Total.		Direct current, constant voltage.		Direct current, constant amperage.		Alternating and polyphase current.								
Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	
18	957	36	835	1,822	151,984	418	23,533	582	37,763	822	90,688	9	176	1	134	900	20	1
.....	.....	.....	.....	14	878	4	153	4	155	6	565	.....	.....	.....	.....	.....	.....	2
.....	.....	.....	.....	13	962	2	70	4	300	7	592	.....	.....	.....	.....	.....	.....	3
.....	.....	.....	.....	23	1,973	7	66	5	180	11	1,727	.....	.....	1	134	.....	.....	4
.....	.....	.....	.....	3	94	1	30	.....	.....	2	64	.....	.....	.....	.....	.....	.....	5
.....	.....	.....	.....	10	520	4	80	2	40	4	400	.....	.....	.....	.....	.....	.....	6
.....	.....	.....	.....	15	700	10	360	.....	.....	5	340	.....	.....	.....	.....	.....	.....	7
.....	.....	.....	.....	14	2,068	4	330	3	375	7	1,363	.....	.....	.....	.....	.....	.....	8
.....	.....	1	100	30	2,101	5	240	7	315	18	1,546	1	15	.....	.....	.....	.....	9
.....	.....	.....	.....	1	90	.....	.....	.....	.....	1	90	.....	.....	.....	.....	.....	.....	10
1	50	3	44	222	24,142	44	2,239	103	14,180	75	7,723	.....	.....	.....	.....	.....	.....	11
5	355	.....	.....	143	12,905	20	1,337	53	2,986	70	8,532	1	3	.....	.....	.....	.....	12
.....	.....	.....	.....	72	5,209	41	2,735	7	348	24	2,126	.....	.....	.....	.....	.....	.....	13
.....	.....	.....	.....	21	1,317	9	530	3	110	9	677	.....	.....	.....	.....	.....	.....	14
.....	.....	.....	.....	20	1,698	4	260	8	400	8	1,038	.....	.....	.....	.....	.....	.....	15
.....	.....	.....	.....	19	1,354	8	322	1	40	10	992	.....	.....	.....	.....	.....	.....	16
.....	.....	1	200	4	270	3	160	.....	.....	1	110	.....	.....	.....	.....	.....	.....	17
.....	.....	.....	.....	9	843	.....	.....	5	263	4	580	.....	.....	.....	.....	.....	.....	18
.....	.....	.....	.....	69	6,551	1	80	31	1,219	37	5,252	.....	.....	.....	.....	.....	.....	19
2	144	6	228	202	17,084	41	2,610	73	3,701	88	10,773	2	52	.....	.....	.....	.....	20
3	105	6	119	133	8,272	70	3,624	17	689	46	3,959	.....	.....	.....	.....	.....	.....	21
.....	.....	.....	.....	32	2,479	9	429	5	187	18	1,863	.....	.....	.....	.....	.....	.....	22
.....	.....	4	20	88	5,880	14	758	32	1,269	42	3,853	1	2	.....	.....	.....	.....	23
.....	.....	.....	.....	4	1,450	2	1,200	.....	.....	2	250	.....	.....	.....	.....	.....	.....	24
.....	.....	.....	.....	17	1,429	7	477	3	110	7	842	.....	.....	.....	.....	.....	.....	25
.....	.....	.....	.....	1	100	.....	.....	.....	.....	1	100	.....	.....	.....	.....	.....	.....	26
.....	.....	.....	.....	8	1,463	.....	.....	1	80	7	1,383	.....	.....	.....	.....	.....	.....	27
.....	.....	1	6	73	5,184	17	934	23	761	33	3,489	.....	.....	.....	.....	900	20	28
.....	.....	1	12	28	2,219	4	145	6	234	18	1,840	.....	.....	.....	.....	.....	.....	29
.....	.....	.....	.....	10	641	7	420	.....	.....	3	221	.....	.....	.....	.....	.....	.....	30
.....	.....	2	9	208	17,304	22	1,559	76	4,040	105	11,705	4	104	.....	.....	.....	.....	31
.....	.....	.....	.....	2	220	.....	.....	.....	.....	2	220	.....	.....	.....	.....	.....	.....	32
.....	.....	.....	.....	9	358	3	39	.....	.....	6	319	.....	.....	.....	.....	.....	.....	33
4	196	7	70	112	7,342	12	526	62	3,419	38	3,397	.....	.....	.....	.....	.....	.....	34
.....	.....	.....	.....	3	125	.....	.....	1	75	2	50	.....	.....	.....	.....	.....	.....	35
.....	.....	.....	.....	15	1,130	2	35	5	280	8	815	.....	.....	.....	.....	.....	.....	36
1	57	.....	.....	11	687	2	63	4	112	5	512	.....	.....	.....	.....	.....	.....	37
.....	.....	.....	.....	29	3,510	9	525	2	98	18	2,887	.....	.....	.....	.....	.....	.....	38
.....	.....	.....	.....	26	2,840	3	120	12	645	11	2,075	.....	.....	.....	.....	.....	.....	39
.....	.....	.....	.....	1	47	.....	.....	.....	.....	1	47	.....	.....	.....	.....	.....	.....	40
.....	.....	.....	.....	22	2,420	3	8	3	70	16	2,342	.....	.....	.....	.....	.....	.....	41
.....	.....	3	22	24	1,342	12	460	4	75	8	807	.....	.....	.....	.....	.....	.....	42
.....	.....	1	10	10	632	4	100	2	100	4	432	.....	.....	.....	.....	.....	.....	43
.....	.....	.....	.....	13	950	.....	.....	9	700	4	250	.....	.....	.....	.....	.....	.....	44
2	50	.....	.....	44	3,211	8	459	6	207	30	2,545	.....	.....	.....	.....	.....	.....	45

TABLE 85.—SUBSTATION EQUIPMENT, TRANSFORMERS, METERS, OUTPUT

	STATE OR TERRITORY.	Number of stations.	SUBSTATION PLANTS.									
			Total horsepower.	Storage battery cells.		Transformers.		Rotary converters.		Miscellaneous.	
				Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.	Number.	Horsepower.
1	United States	815	1,483			35	1,299	1	10	5	174
2	Alabama	9									
3	Arkansas	8									
4	California	10	341			7	341				
5	Colorado	2									
6	Connecticut	3									
7	Delaware	6									
8	Florida	5									
9	Georgia	19	45			2	45				
10	Idaho	1									
11	Illinois	82	50			2	50				
12	Indiana	62									
13	Iowa	38	1			1	1				
14	Kansas	11									
15	Kentucky	8									
16	Louisiana	10									
17	Maine	2									
18	Maryland	5									
19	Massachusetts	17	40			2	40				
20	Michigan	81	375			5	208			3	172
21	Minnesota	70									
22	Mississippi	18									
23	Missouri	43	179			4	169	1	10		
24	Montana	1									
25	Nebraska	11									
26	New Hampshire	1									
27	New Jersey	4									
28	New York	28									
29	North Carolina	16	40			3	40				
30	North Dakota	8									
31	Ohio	88									
32	Oklahoma	2									
33	Oregon	6									
34	Pennsylvania	36									
35	Rhode Island	1									
36	South Carolina	8									
37	South Dakota	6									
38	Tennessee	19	90			3	90				
39	Texas	7									
40	Utah	1									
41	Vermont	11	322			6	320			2	2
42	Virginia	10									
43	Washington	7									
44	West Virginia	6									
45	Wisconsin	28									

OF STATIONS—MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902.

TRANSFORMERS ON CIRCUITS FOR CONSUMERS.		METERS ON CONSUMERS' CIRCUITS.			OUTPUT OF STATIONS.				
					Kilowatt hours.		Horsepower hours of current.		
Number.	Horsepower.	Total.	Mechanical.	Chemical.	Total for year.	Average per day.	Total for year.	Average per day.	
28,070	100,106	56,678	56,576	102	195,904,439	547,771	258,731,016	728,225	1
180	455	30	30	.....	1,053,002	2,919	1,403,759	3,881	2
233	470	14	14	.....	1,119,460	3,058	1,406,916	4,078	3
842	3,380	916	916	.....	2,389,735	6,774	3,186,287	9,032	4
60	84	23	23	.....	86,230	254	114,973	339	5
50	470	151	151	.....	843,844	2,312	1,125,369	3,083	6
53	238	81	81	.....	1,238,525	3,525	1,651,366	4,700	7
477	2,022	1,640	1,640	.....	2,926,888	8,168	3,902,392	10,888	8
730	1,814	909	909	.....	3,488,140	9,555	4,651,936	12,750	9
48	200	18	18	.....	235,790	646	314,385	861	10
2,567	8,182	3,524	3,524	.....	27,660,979	76,727	35,955,271	102,463	11
3,218	9,382	5,705	5,603	102	18,625,210	53,800	24,941,514	71,799	12
586	2,146	3,077	3,977	.....	6,295,299	17,250	8,395,178	20,984	13
191	595	268	268	.....	1,955,901	5,601	2,574,570	7,468	14
287	980	416	416	.....	3,344,115	9,162	4,458,962	12,215	15
222	818	383	383	.....	2,594,410	6,834	3,327,948	9,118	16
3	15	.....	.....	.....	570,130	1,562	760,051	2,083	17
115	273	83	83	.....	913,595	2,503	1,218,127	3,337	18
1,197	5,376	3,977	3,977	.....	4,195,074	9,449	4,598,831	12,599	19
3,125	9,821	7,712	7,712	.....	22,889,897	63,363	30,525,875	84,552	20
1,123	4,256	5,606	5,606	.....	11,113,815	31,248	14,823,023	41,656	21
628	2,086	564	564	.....	3,312,403	9,302	4,316,537	12,403	22
1,365	3,789	1,509	1,509	.....	7,694,232	21,625	10,332,138	28,835	23
115	240	150	150	.....	718,320	1,968	957,760	2,624	24
200	1,127	1,150	1,150	.....	1,509,275	4,135	2,011,880	5,511	25
35	75	39	39	.....	324,120	888	438,000	1,200	26
283	576	654	654	.....	877,095	2,403	1,169,703	3,205	27
1,027	4,831	1,857	1,857	.....	6,752,529	18,674	8,907,505	24,892	28
353	1,958	625	625	.....	2,855,960	7,798	3,798,377	10,397	29
84	209	524	524	.....	1,309,985	3,589	1,746,525	4,785	30
4,059	12,765	6,001	6,001	.....	25,900,884	71,799	34,483,949	95,544	31
32	175	117	117	.....	216,080	592	288,107	789	32
96	263	34	34	.....	550,930	1,482	711,185	1,949	33
1,181	8,929	1,306	1,306	.....	11,023,619	31,051	14,678,191	41,372	34
53	135	111	111	.....	114,975	315	153,300	420	35
282	884	413	413	.....	1,853,213	5,076	2,470,903	6,768	36
59	259	477	477	.....	448,999	1,367	598,422	1,823	37
385	1,592	193	193	.....	3,166,525	12,487	4,115,711	16,647	38
508	1,320	650	650	.....	2,678,140	7,751	3,570,853	10,265	39
37	67	27	27	.....	92,746	254	123,662	338	40
440	2,056	766	766	.....	3,768,260	10,324	4,923,980	13,764	41
174	521	144	144	.....	2,159,517	5,916	2,879,341	7,789	42
509	2,267	2,833	2,833	.....	938,415	2,571	1,254,342	3,428	43
71	130	32	32	.....	1,637,133	4,547	2,182,844	6,062	44
787	2,875	1,969	1,969	.....	2,461,045	7,147	3,281,068	9,529	45

TABLE 86.—ANALYSIS OF SERVICE—MUNICIPAL

	STATE OR TERRITORY.	Number of stations.	ARC LIGHTING—NUMBER OF LAMPS IN SERVICE.															
			Aggregate.	Total.				Direct current.				Alternating current.				All other.			
				Commercial or other private.		Public.		Commercial or other private.		Public.		Commercial or other private.		Public.		Commercial or other private.		Public.	
				Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.
1	United States...	815	50,795	1,366	4,427	30,602	14,400	1,264	1,063	28,639	6,590	102	3,351	1,949	7,798	.....	13	14	12
2	Alabama	9	254	1	29	63	161	1	6	63	69	.....	17	.....	88	.....	6	.....	4
3	Arkansas	8	333	2	4	254	73	.....	3	218	22	2	1	36	51	.....	.....	.....	.....
4	California	10	407	.....	8	303	96	.....	.....	224	2	.....	8	79	94	.....	.....	.....	.....
5	Colorado	2	12	1	.....	11	.....	1	.....	11	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	Connecticut	3	249	.....	28	134	87	.....	20	134	.....	.....	8	.....	87	.....	.....	.....	.....
7	Delaware	6	100	.....	14	.....	86	.....	7	.....	2	.....	7	.....	84	.....	.....	.....	.....
8	Florida	5	602	114	12	217	259	114	.....	217	.....	.....	12	.....	259	.....	.....	.....	.....
9	Georgia	19	793	2	16	369	406	2	.....	313	146	.....	16	56	260	.....	.....	.....	.....
10	Idaho	1	14	.....	.....	.....	14	.....	.....	.....	.....	.....	.....	.....	14	.....	.....	.....	.....
11	Illinois	82	9,901	20	93	8,361	1,427	20	28	8,174	1,098	.....	65	187	329	.....	.....	.....	.....
12	Indiana	62	4,204	219	652	2,182	1,151	219	76	2,091	626	.....	576	91	525	.....	.....	.....	.....
13	Iowa	38	849	24	283	194	348	15	230	169	298	9	53	25	50	.....	.....	.....	.....
14	Kansas	11	776	4	99	474	199	4	49	474	79	.....	50	.....	120	.....	.....	.....	.....
15	Kentucky	8	742	50	50	448	194	50	.....	448	35	.....	50	.....	159	.....	.....	.....	.....
16	Louisiana	10	223	5	26	40	152	.....	.....	40	35	5	26	.....	117	.....	.....	.....	.....
17	Maine	2	192	.....	.....	192	.....	.....	.....	192	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	Maryland	5	497	.....	82	273	142	.....	.....	273	.....	.....	82	.....	142	.....	.....	.....	.....
19	Massachusetts	17	1,731	57	202	1,065	407	27	97	1,065	79	30	105	.....	328	.....	.....	.....	.....
20	Michigan	81	7,238	255	754	4,027	2,202	254	165	3,914	1,203	1	589	113	999	.....	.....	.....	.....
21	Minnesota	70	1,777	160	298	565	754	150	146	418	495	10	145	147	256	.....	7	.....	3
22	Mississippi	18	450	2	70	111	267	2	5	110	108	.....	65	1	159	.....	.....	.....	.....
23	Missouri	43	1,697	107	45	1,045	500	94	11	929	210	13	34	116	290	.....	.....	.....	.....
24	Montana	1	43	8	20	15	.....	8	20	15	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	Nebraska	11	369	33	92	90	154	33	17	90	50	.....	75	.....	104	.....	.....	.....	.....
26	New Hampshire	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
27	New Jersey	4	170	.....	26	.....	144	.....	26	.....	144	.....	.....	.....	.....	.....	.....	.....	.....
28	New York	28	1,825	2	107	1,306	410	.....	1	1,250	82	2	106	56	328	.....	.....	.....	.....
29	North Carolina	16	670	1	129	187	353	1	.....	148	59	.....	129	39	294	.....	.....	.....	.....
30	North Dakota	8	196	.....	18	34	144	.....	18	34	105	.....	.....	.....	34	.....	.....	.....	5
31	Ohio	88	5,702	160	444	3,613	1,485	141	30	3,258	720	19	414	341	765	.....	.....	14	.....
32	Oklahoma	2	40	.....	10	.....	30	.....	.....	.....	.....	.....	10	.....	30	.....	.....	.....	.....
33	Oregon	6	40	4	.....	13	23	4	.....	13	.....	.....	.....	.....	23	.....	.....	.....	.....
34	Pennsylvania	36	3,539	85	77	2,888	489	85	22	2,354	223	.....	55	584	266	.....	.....	.....	.....
35	Rhode Island	1	55	.....	.....	.....	55	.....	.....	.....	55	.....	.....	.....	.....	.....	.....	.....	.....
36	South Carolina	8	360	2	.....	266	92	1	.....	266	1	1	.....	.....	91	.....	.....	.....	.....
37	South Dakota	6	172	.....	18	.....	154	.....	18	.....	132	.....	.....	.....	22	.....	.....	.....	.....
38	Tennessee	19	971	.....	37	107	827	.....	16	34	115	.....	21	73	712	.....	.....	.....	.....
39	Texas	7	627	10	10	462	145	.....	10	432	137	10	.....	30	8	.....	.....	.....	.....
40	Utah	1	1	.....	1	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....
41	Vermont	11	85	3	8	72	2	3	1	72	2	.....	7	.....	.....	.....	.....	.....	.....
42	Virginia	10	526	4	9	413	100	4	1	413	10	.....	8	.....	90	.....	.....	.....	.....
43	Washington	7	967	17	579	53	318	17	.....	53	.....	.....	579	.....	318	.....	.....	.....	.....
44	West Virginia	6	682	.....	.....	507	175	.....	.....	507	94	.....	.....	.....	81	.....	.....	.....	.....
45	Wisconsin	28	714	14	77	248	375	14	40	228	154	.....	37	25	221	.....	.....	.....	.....

STATIONS, BY STATES AND TERRITORIES: 1902.

Aggregate.	INCANDESCENT LIGHTING—NUMBER OF LAMPS IN SERVICE.								MOTOR SERVICE.			
	Total.		16-candlepower.		32-candlepower.		All other candlepower.		Stationary.		Railway car.	
	Commercial or other private.	Public.	Commercial or other private.	Public.	Commercial or other private.	Public.	Commercial or other private.	Public.	Number.	Horse-power.	Number of cars served.	
1,577,451	1,494,531	82,920	1,370,786	60,934	30,433	12,925	93,312	9,061	1,962	3,324	9	1
8,385	8,138	247	7,938	247	200	.....	.....	.....	8	10	.....	2
7,043	6,900	143	6,845	55	50	30	5	58	20	2	.....	3
29,491	27,279	2,212	25,338	1,717	105	114	1,841	381	78	440	6	4
955	905	50	665	20	20	24	220	6	.....	.....	.....	5
11,369	10,828	541	9,802	523	100	18	1,426	.....	45	100	.....	6
7,445	6,751	694	5,234	470	70	124	1,447	100	.....	.....	.....	7
30,740	29,885	855	29,885	695	.....	.....	.....	160	47	404	.....	8
25,503	24,627	876	24,123	759	504	46	.....	71	.....	.....	.....	9
1,033	1,023	10	1,023	10	.....	.....	.....	.....	.....	.....	.....	10
123,626	115,885	7,741	107,999	4,691	2,002	2,119	5,884	931	10	18	.....	11
134,333	130,998	3,335	120,780	2,920	1,810	287	8,408	178	364	108	.....	12
77,501	74,313	3,188	66,851	1,450	4,767	1,483	2,695	255	17	30	.....	13
8,745	8,523	222	6,229	111	473	77	1,821	34	100	21	.....	14
11,385	11,325	60	10,370	50	540	10	415	.....	18	59	.....	15
15,692	14,360	1,332	13,355	692	422	333	583	247	246	34	.....	16
300	.....	300	.....	.....	.....	300	.....	.....	.....	.....	.....	17
2,260	2,100	160	2,000	50	100	110	.....	.....	.....	.....	.....	18
94,439	90,000	4,439	89,968	4,689	28	1,207	4	1,543	42	184	.....	19
205,609	188,649	16,960	157,164	16,056	5,689	614	25,796	290	232	464	.....	20
137,942	134,243	3,699	124,680	2,345	2,911	1,116	6,652	238	29	150	.....	21
27,205	26,642	563	25,264	325	888	174	490	64	144	17	.....	22
55,509	53,006	2,503	50,846	1,097	806	508	1,354	898	94	141	3	23
2,825	2,825	.....	2,500	.....	25	.....	300	.....	10	4	.....	24
22,426	21,227	1,199	21,027	1,000	200	199	.....	.....	15	25	.....	25
1,664	1,524	140	1,524	.....	.....	140	.....	.....	.....	.....	.....	26
16,160	15,440	720	15,090	100	150	620	200	.....	4	1	.....	27
59,432	55,131	4,301	49,973	3,816	1,016	275	4,142	210	24	82	.....	28
21,477	20,724	753	19,847	502	677	30	200	221	.....	180	.....	29
9,960	9,644	316	9,644	316	.....	.....	.....	.....	.....	.....	.....	30
171,587	166,737	4,850	159,689	4,474	1,051	363	5,997	13	169	299	.....	31
3,500	3,370	130	3,070	130	300	.....	.....	.....	.....	.....	.....	32
3,411	3,199	212	2,063	152	76	60	1,060	.....	.....	.....	.....	33
54,023	42,154	11,869	36,419	10,192	1,058	1,055	4,677	622	16	24	.....	34
1,500	1,500	.....	1,500	.....	.....	.....	.....	.....	.....	.....	.....	35
10,520	10,260	260	9,960	256	100	.....	200	4	.....	.....	.....	36
13,223	13,052	171	9,576	49	212	122	3,264	.....	.....	.....	.....	37
17,377	15,554	1,823	15,274	494	90	94	190	1,235	.....	.....	.....	38
17,934	16,260	1,674	16,160	812	100	62	.....	800	137	280	.....	39
1,035	963	72	878	72	10	.....	75	.....	.....	.....	.....	40
33,325	31,672	1,653	27,091	619	347	635	4,234	399	10	137	.....	41
7,263	6,942	321	6,650	210	80	50	212	61	47	8	.....	42
36,084	35,274	810	28,859	646	2,572	164	3,843	.....	41	57	.....	43
2,556	2,484	72	2,102	15	71	15	311	42	.....	.....	.....	44
53,659	52,215	1,444	46,036	1,107	813	337	5,366	.....	.....	.....	.....	45

TABLE 87.—EQUIPMENT, OUTPUT, AND ARC AND INCANDESCENT LAMPS—PURELY ELECTRIC PRIVATE STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	1,759	1,345	277	76	44	17
Steam engines:						
Number, total	3,053	1,595	577	338	304	239
Horsepower, total	809,249	195,529	115,469	128,656	166,812	202,783
500 horsepower and under—						
Number	2,751	1,593	568	271	200	119
Horsepower	450,019	193,779	106,319	70,366	50,662	28,893
Over 500 but under 1,000 horsepower—						
Number	160	1	5	53	56	45
Horsepower	112,430	750	3,650	37,440	41,050	29,540
1,000 horsepower and over—						
Number	142	1	4	14	48	75
Horsepower	246,800	1,000	5,500	20,850	75,100	144,350
Water wheels:						
Number	896	499	220	126	51	.....
Horsepower	336,029	96,291	139,025	58,060	42,653	.....
Gas engines:						
Number	83	66	13	.....	3	1
Horsepower	6,242	3,459	1,323	.....	1,260	200
Dynamos:						
Number, total	6,783	2,843	1,375	959	737	869
Horsepower, total	1,009,412	248,779	211,855	182,568	199,416	166,794
Direct current, constant voltage—						
Number	2,078	851	411	337	265	214
Horsepower	268,756	47,480	37,878	49,804	67,579	66,020
Direct current, constant amperage—						
Number	1,841	443	405	352	307	334
Horsepower	101,973	19,139	17,765	23,798	21,487	19,789
Alternating and polyphase current—						
Number	2,864	1,549	559	270	165	321
Horsepower	638,683	182,160	156,217	108,971	110,350	80,985
Output of stations, kilowatt hours, total for year	1,716,909,602	301,282,016	610,449,392	225,788,099	284,544,168	294,895,927
Arc lighting—number of lamps in service:						
Aggregate	219,409	28,766	30,806	40,676	55,606	63,555
Commercial or other private, total	107,743	8,590	13,469	19,949	27,924	37,811
Open	29,871	2,443	3,053	3,064	3,820	17,491
Inclosed	77,872	6,147	10,416	16,885	24,104	20,320
Public, total	111,666	20,176	17,337	20,727	27,682	25,744
Open	70,939	11,538	10,678	12,271	18,477	17,975
Inclosed	40,727	8,638	6,659	8,456	9,205	7,769
Incandescent lighting—number of lamps in service:						
Aggregate	11,463,050	2,383,717	1,458,719	1,426,314	2,357,842	3,836,458
Commercial or other private, total	11,195,351	2,306,796	1,420,795	1,407,699	2,341,412	3,718,649
16 candlepower	9,261,524	2,077,584	1,287,343	1,300,888	2,028,906	2,566,803
32 candlepower	326,882	60,709	24,321	40,277	44,602	156,973
All other candlepower	1,606,945	168,503	109,131	66,534	267,904	994,873
Public, total	267,699	76,921	37,924	18,615	16,430	117,809
16 candlepower	168,664	38,764	26,156	9,357	11,358	83,029
32 candlepower	32,539	18,897	3,742	2,270	2,160	5,470
All other candlepower	66,496	19,260	8,026	6,988	2,912	29,310

TABLE 88.—EQUIPMENT, OUTPUT, AND ARC AND INCANDESCENT LAMPS—COMPOSITE PRIVATE STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	1,046	698	277	39	23	9
Steam engines:						
Number, total	1,817	768	671	149	156	73
Horsepower, total	423,674	87,821	149,177	55,648	85,158	45,870
500 horsepower and under—						
Number	1,656	763	640	108	103	42
Horsepower	265,399	84,121	116,742	24,498	29,558	10,480
Over 500 but under 1,000 horsepower—						
Number	106	5	19	32	34	16
Horsepower	72,240	3,700	13,500	21,600	24,350	9,090
1,000 horsepower and over—						
Number	55	.....	12	9	19	15
Horsepower	86,035	.....	18,935	9,550	31,250	26,300
Water wheels:						
Number	412	238	94	41	39	.....
Horsepower	91,225	29,181	22,959	17,347	21,738	.....
Gas engines:						
Number	64	37	18	7	2	.....
Horsepower	4,962	2,517	1,535	580	350	.....
Dynamos:						
Number, total	3,879	1,299	1,421	491	483	185
Horsepower, total	463,584	100,214	157,883	71,998	89,777	43,712
Direct current, constant voltage—						
Number	1,327	445	420	186	206	70
Horsepower	150,157	22,328	38,349	21,322	46,816	21,342
Direct current, constant amperage—						
Number	1,116	186	458	196	194	82
Horsepower	55,795	7,427	21,111	11,669	11,928	3,660
Alternating and polyphase current—						
Number	1,436	668	543	109	83	33
Horsepower	257,632	70,459	98,423	39,007	31,033	18,710
Output of stations, kilowatt hours, total for year	594,237,074	114,592,524	200,467,591	88,973,142	132,098,818	58,109,999
Arc lighting—number of lamps in service:						
Aggregate	115,494	13,647	35,479	21,663	29,885	14,820
Commercial or other private, total	60,437	4,166	14,403	12,125	17,069	12,654
Open	11,751	990	3,370	2,110	2,463	2,818
Inclosed	48,686	3,176	11,033	10,015	14,626	9,836
Public, total	55,057	9,481	21,076	9,538	12,796	2,166
Open	37,143	4,833	18,044	6,361	11,606	1,299
Inclosed	17,914	4,648	8,032	3,177	1,190	867
Incandescent lighting—number of lamps in service:						
Aggregate	5,153,543	1,035,108	1,429,518	750,916	1,121,782	816,269
Commercial or other private, total	5,048,502	1,008,868	1,397,358	734,597	1,098,648	809,031
16 candlepower	4,628,757	923,693	1,282,577	659,406	967,884	805,197
32 candlepower	157,364	30,052	38,745	14,328	73,408	831
All other candlepower	262,381	55,123	76,036	60,863	67,356	3,003
Public, total	105,041	26,240	32,160	16,319	23,064	7,238
16 candlepower	67,178	13,274	21,108	11,064	14,517	7,220
32 candlepower	14,524	6,651	3,353	762	3,741	17
All other candlepower	23,339	6,315	7,704	4,493	4,826	1

TABLE 89.—EQUIPMENT, OUTPUT, AND ARC AND INCANDESCENT LAMPS—PURELY ELECTRIC MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	380	288	73	10	6	3
Steam engines:						
Number, total	519	325	127	22	31	14
Horsepower, total	81,890	36,297	24,447	6,221	5,745	9,180
500 horsepower and under—						
Number	504	325	126	19	30	4
Horsepower	69,390	36,297	23,797	3,971	4,845	480
Over 500 but under 1,000 horsepower—						
Number	11	.....	1	3	1	6
Horsepower	8,300	.....	650	2,250	900	4,500
1,000 horsepower and over—						
Number	4	.....	.....	.....	.....	4
Horsepower	4,200	.....	.....	.....	.....	4,200
Water wheels:						
Number	61	42	17	.....	2	.....
Horsepower	8,798	5,718	2,830	.....	250	.....
Gas engines:						
Number	3	3	.....	.....	.....	.....
Horsepower	154	154	.....	.....	.....	.....
Dynamos:						
Number, total	969	515	269	47	72	66
Horsepower, total	88,182	37,151	25,896	6,146	5,714	13,275
Direct current, constant voltage—						
Number	213	147	38	14	6	8
Horsepower	11,669	7,740	2,388	1,122	144	275
Direct current, constant amperage—						
Number	358	98	123	22	60	55
Horsepower	27,487	4,803	6,451	1,631	3,702	11,400
Alternating and polyphase current—						
Number	398	270	108	11	6	3
Horsepower	49,026	25,108	17,057	3,393	1,868	1,600
Output of stations, kilowatt hours, total for year	119,839,234	46,728,978	41,528,669	6,783,700	9,548,807	15,254,080
Arc lighting—number of lamps in service:						
Aggregate	32,998	8,678	9,900	3,987	4,544	5,889
Commercial or other private, total	3,682	1,313	1,614	755	.....	.....
Open	872	349	409	114	.....	.....
Inclosed	2,810	964	1,205	641	.....	.....
Public, total	29,316	7,365	8,286	3,232	4,544	5,889
Open	21,462	3,885	6,331	1,443	3,985	5,868
Inclosed	7,854	3,530	1,955	1,789	559	21
Incandescent lighting—number of lamps in service:						
Aggregate	785,868	431,794	265,676	65,578	21,620	1,200
Commercial or other private, total	732,929	415,341	253,519	62,145	1,924	.....
16 candlepower	686,209	383,508	243,332	57,645	1,724	.....
32 candlepower	13,464	8,744	3,020	1,500	200	.....
All other candlepower	33,256	23,089	7,167	3,000	.....	.....
Public, total	52,939	16,453	12,157	3,433	19,696	1,200
16 candlepower	40,735	10,073	8,433	2,197	18,832	1,200
32 candlepower	6,350	4,222	1,323	86	719	.....
All other candlepower	5,854	2,158	2,401	1,150	145	.....

TABLE 90.—EQUIPMENT, OUTPUT, AND ARC AND INCANDESCENT LAMPS—COMPOSITE MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO POPULATION OF PLACES IN WHICH LOCATED: 1902.

	Total.	POPULATION OF PLACES IN WHICH LOCATED.				
		Under 5,000.	5,000 but under 25,000.	25,000 but under 100,000.	100,000 but under 500,000.	500,000 and over.
Number of stations	435	383	48	3	.....	1
Steam engines:						
Number, total	541	453	78	6	.....	4
Horsepower, total	65,128	50,683	12,335	1,490	.....	620
500 horsepower and under—						
Number	540	453	77	6	.....	4
Horsepower	64,528	50,683	11,735	1,490	.....	620
Over 500 but under 1,000 horsepower—						
Number	1	.....	1	.....	.....	.....
Horsepower	600	.....	600	.....	.....	.....
1,000 horsepower and over—						
Number	.....	.....	.....	.....	.....	.....
Horsepower	.....	.....	.....	.....	.....	.....
Water wheels:						
Number	21	19	2	.....	.....	.....
Horsepower	2,420	2,165	255	.....	.....	.....
Gas engines:						
Number	15	14	1	.....	.....	.....
Horsepower	803	703	100	.....	.....	.....
Dynamos:						
Number, total	853	680	149	19	.....	5
Horsepower, total	63,802	49,511	12,933	1,085	.....	273
Direct current, constant voltage—						
Number	205	179	23	3	.....	.....
Horsepower	11,864	10,289	1,455	120	.....	.....
Direct current, constant amperage—						
Number	224	133	72	15	.....	4
Horsepower	10,276	5,387	3,771	905	.....	213
Alternating and polyphase current—						
Number	424	368	54	1	.....	1
Horsepower	41,662	33,835	7,707	60	.....	60
Output of stations, kilowatt hours, total for year	76,065,205	58,789,315	14,757,390	2,146,200	.....	372,300
Arc lighting—number of lamps in service:						
Aggregate	17,797	10,933	5,801	813	.....	250
Commercial or other private, total	2,111	1,359	752	.....	.....	.....
Open	494	384	110	.....	.....	.....
Inclosed	1,617	975	642	.....	.....	.....
Public, total	15,686	9,574	5,049	813	.....	250
Open	9,140	5,102	3,037	751	.....	250
Inclosed	6,546	4,472	2,012	62	.....	.....
Incandescent lighting—number of lamps in service:						
Aggregate	791,583	663,152	125,969	1,262	.....	1,200
Commercial or other private, total	761,602	639,288	122,314	.....	.....	.....
16 candlepower	684,577	575,129	109,448	.....	.....	.....
32 candlepower	16,969	13,990	2,979	.....	.....	.....
All other candlepower	60,056	50,169	9,887	.....	.....	.....
Public, total	29,981	23,864	3,655	1,262	.....	1,200
16 candlepower	20,199	15,571	2,966	462	.....	1,200
32 candlepower	6,575	5,965	610	.....	.....	.....
All other candlepower	3,207	2,328	79	800	.....	.....

TABLE 91.—EQUIPMENT, OUTPUT, AND ARC AND INCANDESCENT LAMPS—PURELY ELECTRIC PRIVATE STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.	2,000 but under 5,000.	5,000 and over.
Number of stations	1,759	1,026	445	121	78	56	33
Steam engines:							
Number, total	3,053	1,038	784	315	268	283	365
Horsepower, total	809,249	99,514	118,144	70,698	86,427	113,410	321,056
500 horsepower and under—							
Number	2,751	1,037	783	310	245	214	162
Horsepower	450,019	98,864	117,394	67,198	66,772	55,325	44,466
Over 500 but under 1,000 horsepower—							
Number	160	1	1	4	17	55	82
Horsepower	112,430	650	750	2,500	12,155	38,235	58,140
1,000 horsepower and over—							
Number	142	.....	.....	1	6	14	121
Horsepower	246,800	.....	.....	1,000	7,500	19,850	218,450
Water wheels:							
Number	896	232	201	85	127	117	134
Horsepower	336,029	20,557	31,383	19,620	37,626	81,635	145,208
Gas engines:							
Number	83	60	11	8	.....	1	3
Horsepower	6,242	2,752	1,015	1,015	.....	200	1,260
Dynamos:							
Number, total	6,783	1,716	1,474	708	702	862	1,321
Horsepower, total	1,009,412	96,575	129,650	79,754	113,204	175,233	414,996
Direct current, constant voltage—							
Number	2,078	589	354	248	234	313	340
Horsepower	268,756	23,985	22,792	22,581	31,359	55,471	112,568
Direct current, constant amperage—							
Number	1,841	262	325	193	226	330	505
Horsepower	101,973	9,278	15,253	9,398	13,920	19,458	34,666
Alternating and polyphase current—							
Number	2,864	865	795	267	242	219	476
Horsepower	638,683	63,312	91,605	47,775	67,925	100,304	267,762
Output of stations, kilowatt hours, total for year	1,716,909,602	137,413,787	161,858,269	112,069,100	148,552,179	274,633,940	882,882,327
Arc lighting—number of lamps in service:							
Aggregate	219,409	16,660	22,096	16,146	26,480	39,048	98,979
Commercial or other private, total	107,743	4,664	8,044	6,845	13,599	19,821	54,770
Open	29,871	1,361	2,031	1,801	1,906	4,272	18,500
Inclosed	77,872	3,303	6,013	5,044	11,693	15,549	36,270
Public, total	111,666	11,996	14,052	9,301	12,881	19,227	44,209
Open	70,939	7,031	8,211	5,676	7,983	9,346	32,692
Inclosed	40,727	4,965	5,841	3,625	4,898	9,881	11,517
Incandescent lighting—number of lamps in service:							
Aggregate	11,463,050	1,259,022	1,492,466	801,130	1,001,977	1,300,055	5,608,400
Commercial or other private, total	11,195,351	1,212,655	1,451,744	779,914	985,077	1,282,659	5,483,302
16 candlepower	9,261,524	1,109,193	1,299,741	689,827	914,564	1,175,678	4,072,521
32 candlepower	326,882	30,659	36,246	15,089	27,601	35,295	181,992
All other candlepower	1,606,945	72,803	115,757	74,998	42,912	71,686	1,228,789
Public, total	267,699	46,367	40,722	21,216	16,900	17,396	125,098
16 candlepower	168,664	23,098	23,600	12,309	9,365	14,051	86,241
32 candlepower	37,539	13,849	6,247	1,942	2,523	1,136	6,842
All other candlepower	66,496	9,420	10,875	6,965	5,012	2,209	32,015

TABLE 92.—EQUIPMENT, OUTPUT, AND ARC AND INCANDESCENT LAMPS—COMPOSITE PRIVATE STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.	2,000 but under 5,000.	5,000 and over.
Number of stations	1,046	624	255	80	48	25	14
Steam engines:							
Number, total	1,817	654	472	227	202	98	169
Horsepower, total	423,674	62,641	75,699	48,741	61,160	53,050	122,383
500 horsepower and under—							
Number	1,656	654	470	223	179	44	86
Horsepower	265,399	62,641	74,399	46,391	41,960	11,465	28,543
Over 500 but under 1,000 horsepower—							
Number	106	.....	2	4	16	36	48
Horsepower	72,240	.....	1,300	2,350	10,700	24,500	33,390
1,000 horsepower and over—							
Number	55	.....	.....	.....	7	13	35
Horsepower	86,035	.....	.....	.....	8,500	17,085	60,450
Water wheels:							
Number	412	155	83	40	31	37	66
Horsepower	91,225	12,231	11,583	8,001	7,406	16,666	35,338
Gas engines:							
Number	64	33	17	7	5	1	1
Horsepower	4,982	1,522	1,780	880	480	20	300
Dynamos:							
Number, total	3,879	1,040	896	507	514	293	629
Horsepower, total	463,584	56,784	75,786	55,229	61,826	74,423	139,536
Direct current, constant voltage—							
Number	1,327	381	253	159	195	100	289
Horsepower	150,157	16,568	15,856	16,537	19,808	15,460	65,928
Direct current, constant amperage—							
Number	1,116	188	227	160	164	97	280
Horsepower	55,795	6,472	10,385	8,334	8,033	7,021	15,550
Alternating and polyphase current—							
Number	1,436	471	416	188	155	96	110
Horsepower	257,632	33,744	49,545	30,358	33,985	51,942	58,058
Output of stations, kilowatt hours, total for year	594,237,074	77,110,130	103,693,130	64,896,748	76,634,639	66,442,134	205,460,293
Arc lighting—number of lamps in service:							
Aggregate	115,494	10,429	17,261	13,361	16,768	13,504	44,171
Commercial or other private, total	60,437	2,930	6,183	6,421	7,791	7,218	29,894
Open	11,751	929	1,509	1,407	1,290	1,191	5,425
Inclosed	48,686	2,001	4,674	5,014	6,501	6,027	24,469
Public, total	55,057	7,499	11,078	6,940	8,977	6,286	14,277
Open	37,143	4,301	6,767	4,647	4,919	3,948	12,561
Inclosed	17,914	3,198	4,311	2,293	4,058	2,338	1,716
Incandescent lighting—number of lamps in service:							
Aggregate	5,153,543	675,234	833,543	556,876	664,026	588,215	1,835,649
Commercial or other private, total	5,048,502	655,014	816,372	548,377	646,024	574,636	1,808,079
16 candlepower	4,628,757	605,240	727,068	484,433	584,421	548,035	1,679,560
32 candlepower	157,364	20,706	25,007	14,721	17,839	9,273	69,818
All other candlepower	262,381	29,068	64,297	49,223	43,764	17,328	58,701
Public, total	105,041	20,220	17,171	8,499	18,002	13,579	27,570
16 candlepower	67,178	10,575	10,902	4,304	13,545	8,849	19,003
32 candlepower	14,524	5,549	1,642	920	782	1,890	3,741
All other candlepower	23,339	4,096	4,627	3,275	3,675	2,840	4,826

TABLE 93.—EQUIPMENT, OUTPUT, AND ARC AND INCANDESCENT LAMPS—PURELY ELECTRIC MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.					
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.	2,000 but under 5,000.	5,000 and over.
Number of stations	380	269	78	22	8	2	1
Steam engines:							
Number, total	519	283	128	46	38	17	7
Horsepower, total	81,890	28,475	21,140	11,270	10,330	4,075	6,600
500 horsepower and under—							
Number	504	283	128	46	32	15	.....
Horsepower	69,390	28,475	21,140	11,270	5,930	2,575	.....
Over 500 but under 1,000 horsepower—							
Number	11	.....	.....	.....	6	2	3
Horsepower	8,300	.....	.....	.....	4,400	1,500	2,400
1,000 horsepower and over—							
Number	4	.....	.....	.....	.....	.....	4
Horsepower	4,200	.....	.....	.....	.....	.....	4,200
Water wheels:							
Number	61	33	21	2	5	.....	.....
Horsepower	8,798	3,876	2,852	1,640	430	.....	.....
Gas engines:							
Number	3	3	.....	.....	.....	.....	.....
Horsepower	154	154	.....	.....	.....	.....	.....
Dynamos:							
Number, total	969	446	243	119	71	35	55
Horsepower, total	88,182	26,812	22,396	13,222	11,084	7,443	7,225
Direct current, constant voltage—							
Number	213	138	38	20	7	2	8
Horsepower	11,669	6,868	2,943	1,144	379	60	275
Direct current, constant amperage—							
Number	358	103	94	43	42	30	46
Horsepower	27,487	4,546	5,284	1,910	2,947	5,900	6,900
Alternating and polyphase current—							
Number	398	205	111	56	22	3	1
Horsepower	49,026	15,398	14,169	10,168	7,758	1,483	50
Output of stations, kilowatt hours, total for year	119,839,234	39,318,261	27,101,557	20,540,374	15,759,082	5,807,880	11,312,080
Arc lighting—number of lamps in service:							
Aggregate	32,998	8,809	8,276	4,077	4,545	2,829	4,462
Commercial or other private, total	3,682	773	996	1,330	583	.....	.....
Open	872	273	201	284	114	.....	.....
Inclosed	2,810	500	795	1,046	469	.....	.....
Public, total	29,316	8,036	7,280	2,747	3,962	2,829	4,462
Open	21,462	5,055	4,636	1,841	2,997	2,492	4,441
Inclosed	7,854	2,981	2,644	906	965	337	21
Incandescent lighting—number of lamps in service:							
Aggregate	785,868	298,697	226,991	163,725	84,065	12,190	200
Commercial or other private, total	732,929	285,397	216,945	157,038	73,125	424	.....
16 candlepower	686,209	260,587	204,129	151,144	70,125	224	.....
32 candlepower	13,464	7,556	2,858	1,851	1,000	200	.....
All other candlepower	33,256	17,255	9,958	4,043	2,000	.....	.....
Public, total	52,939	13,300	10,046	6,687	10,940	11,766	200
16 candlepower	40,735	7,311	6,712	5,955	8,791	11,766	200
32 candlepower	6,350	3,816	1,559	134	841	.....	.....
All other candlepower	5,854	2,173	1,775	598	1,308	.....	.....

TABLE 94.—EQUIPMENT, OUTPUT, AND ARC AND INCANDESCENT LAMPS—COMPOSITE MUNICIPAL STATIONS, CLASSIFIED ACCORDING TO HORSEPOWER CAPACITY OF DYNAMOS: 1902.

	Total.	HORSEPOWER CAPACITY OF DYNAMOS.			
		Under 200.	200 but under 500.	500 but under 1,000.	1,000 but under 2,000.[1]
Number of stations	435	343	86	3	3
Steam engines:					
Number, total	541	374	151	7	9
Horsepower, total	65,128	38,277	22,351	2,100	2,400
500 horsepower and under—					
Number	540	374	151	7	8
Horsepower	64,528	38,277	22,351	2,100	1,800
Over 500 but under 1,000 horsepower—					
Number	1	.....	.....	.....	1
Horsepower	600	.....	.....	.....	600
Water wheels:					
Number	21	11	10	.....	.....
Horsepower	2,420	1,143	1,277	.....	.....
Gas engines:					
Number	15	14	1	.....	.....
Horsepower	803	678	125	.....	.....
Dynamos:					
Number, total	853	559	251	17	26
Horsepower, total	63,802	34,218	22,951	2,073	4,560
Direct current, constant voltage—					
Number	205	171	30	2	2
Horsepower	11,864	8,194	2,325	145	1,200
Direct current, constant amperage—					
Number	224	125	78	10	11
Horsepower	10,276	5,011	4,133	612	520
Alternating and polyphase current—					
Number	424	263	143	5	13
Horsepower	41,662	21,013	16,493	1,316	2,840
Output of stations, kilowatt hours, total for year	76,065,205	48,137,072	24,339,818	2,167,735	1,420,580
Arc lighting—number of lamps in service:					
Aggregate	17,797	10,406	6,177	583	631
Commercial or other private, total	2,111	868	990	.....	253
Open	494	204	282	.....	8
Inclosed	1,617	664	708	.....	245
Public, total	15,686	9,538	5,187	583	378
Open	9,140	4,971	3,208	583	378
Inclosed	6,546	4,567	1,979	.....	.....
Incandescent lighting—number of lamps in service:					
Aggregate	791,583	463,124	278,674	16,160	33,625
Commercial or other private, total	761,602	443,947	268,960	15,570	33,125
16 candlepower	684,577	397,450	240,837	13,490	32,800
32 candlepower	16,969	10,669	5,775	500	25
All other candlepower	60,056	35,828	22,348	1,580	300
Public, total	29,981	19,177	9,714	590	500
16 candlepower	20,199	12,505	7,084	110	500
32 candlepower	6,575	4,238	1,857	480	.....
All other candlepower	3,207	2,434	773	.....	.....

[1] No dynamos of over 2,000 horsepower capacity reported for this class.

TABLE 95.—NUMBER OF WAGE-EARNERS AT SPECIFIED DAILY RATES OF PAY,

	STATE OR TERRITORY.	ALL CLASSES.														FOREMEN AND INSPECTORS.						
		Total.	Less than $1.00	$1.00 to $1.24	$1.25 to $1.49.	$1.50 to $1.74.	$1.75 to $1.99.	$2.00 to $2.24.	$2.25 to $2.49.	$2.50 to $2.74.	$2.75 to $2.99	$3.00 to $3.24	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	Total.	Less than $1.00	$1.00 to $1.24	$1.25 to $1.49	$1.50 to $1.74	$1.75 to $1.99
1	United States...	16,721	257	789	1,319	2,940	2,081	3,671	1,604	1,733	794	798	284	189	262	2.00 to 2.04	1,441	16	19	44	102	99
2	Alabama	79	2	18	17	21	1	6	4	6	.....	2	.....	2	.....	1.50 to 1.54	6	.....	.....	.....	2	1
3	Arizona	54	1	.....	.....	3	3	7	8	4	4	7	2	9	6	2.75 to 2.79	2	.....	.....	.....	.....	.....
4	Arkansas	75	1	11	11	29	1	11	3	6	.....	1	.....	1	.....	1.65 to 1.69	2	.....	.....	.....	.....	.....
5	California	706	.....	5	11	17	40	102	126	172	78	76	30	27	22	2.50 to 2.54	99	.....	1	1	.....	.....
6	Colorado	311	.....	4	4	9	5	98	23	47	28	43	21	16	13	2.50 to 2.54	32	.....	1	.....	.....	.....
7	Connecticut	234	.....	3	8	22	15	82	18	44	7	13	4	15	3	2.00 to 2.04	21	.....	.....	.....	1	2
8	Florida	50	4	7	12	9	3	6	4	2	.....	.....	3	.....	.....	1.50 to 1.54	4	.....	.....	1	1	.....
9	Georgia	76	11	24	15	10	2	6	2	2	2	1	.....	.....	1	1.30 to 1.34	6	.....	.....	.....	.....	1
10	Idaho	57	.....	.....	1	3	1	7	4	4	11	10	14	1	1	2.85 to 2.89	9	.....	.....	.....	.....	.....
11	Illinois	1,293	26	106	144	211	270	283	68	75	37	60	15	1	2	1.75 to 1.79	112	2	1	1	10	32
12	Indiana	426	8	32	73	114	72	71	19	22	8	2	3	1	1	1.65 to 1.69	35	.....	1	1	3	9
13	Indian Territory	29	.....	1	4	15	.....	4	1	3	.....	.....	1	.....	.....	1.65 to 1.69	1	.....	.....	.....	.....	.....
14	Iowa	374	14	45	104	92	31	40	31	12	1	3	.....	.....	1	1.60 to 1.64	18	.....	.....	1	6	3
15	Kansas	174	3	10	17	39	31	33	28	5	4	2	1	1	.....	1.75 to 1.79	14	.....	.....	.....	.....	1
16	Kentucky	170	3	37	17	34	8	43	6	15	.....	4	.....	1	2	1.65 to 1.69	7	.....	.....	.....	1	.....
17	Louisiana	164	1	3	3	58	22	18	1	38	3	7	2	3	5	1.95 to 1.99	13	.....	.....	.....	.....	3
18	Maine	188	2	4	12	38	39	50	14	19	4	3	1	1	1	1.85 to 1.89	17	.....	.....	.....	.....	2
19	Maryland	199	2	4	6	69	8	35	19	42	.....	13	1	.....	.....	2.00 to 2.04	18	.....	.....	.....	.....	.....
20	Massachusetts	1,023	2	7	12	121	104	279	111	225	50	46	20	5	41	2.10 to 2.14	107	.....	4	.....	8	2
21	Michigan	530	16	36	83	132	47	98	46	43	11	5	7	2	4	1.70 to 1.74	67	7	3	6	14	4
22	Minnesota	313	3	8	26	57	44	71	44	43	6	3	4	1	3	2.00 to 2.04	19	.....	.....	.....	4	.....
23	Mississippi	88	7	11	23	26	2	6	3	6	2	2	.....	.....	.....	1.50 to 1.54	10	.....	.....	1	3	1
24	Missouri	561	12	27	56	85	71	97	40	48	34	55	9	14	13	2.00 to 2.04	85	.....	.....	5	5	4
25	Montana	114	.....	.....	.....	4	2	3	6	14	8	31	7	12	27	3.00 to 3.04	18	.....	.....	.....	1	.....
26	Nebraska	141	2	4	17	23	37	16	8	13	6	12	2	.....	1	1.75 to 1.79	10	.....	1	.....	1	1
27	Nevada	9	.....	.....	1	.....	.....	2	1	1	.....	3	1	.....	.....	2.60 to 2.64	2	.....	.....	.....	.....	.....
28	New Hampshire	174	2	1	10	36	41	45	16	14	2	5	1	.....	1	1.90 to 1.94	14	.....	.....	.....	.....	.....
29	New Jersey	696	4	9	39	91	122	167	85	67	68	19	5	10	10	2.00 to 2.04	68	1	1	11	2	5
30	New Mexico	27	.....	2	.....	1	.....	9	1	7	1	2	3	1	.....	2.50 to 2.54	2	.....	.....	.....	.....	.....
31	New York	3,362	17	53	132	412	421	911	457	343	270	182	57	47	60	2.00 to 2.04	245	.....	2	2	8	8
32	North Carolina	42	7	14	5	6	3	1	2	.....	1	1	2	.....	.....	1.25 to 1.29	2	.....	.....	.....	.....	.....
33	North Dakota	29	.....	.....	1	2	5	8	5	7	1	.....	.....	.....	.....	2.00 to 2.04	.....	.....	.....	.....	.....	.....
34	Ohio	893	18	33	78	251	107	234	44	66	14	31	13	3	1	1.75 to 1.79	64	3	.....	1	10	3
35	Oklahoma	35	.....	2	6	14	.....	5	4	1	2	.....	1	.....	.....	1.65 to 1.69	2	.....	.....	.....	.....	.....
36	Oregon	125	1	6	6	8	5	39	20	6	5	21	7	.....	1	2.15 to 2.19	11	.....	.....	.....	.....	.....
37	Pennsylvania	2,081	20	94	163	445	345	461	183	186	75	66	18	7	18	1.85 to 1.89	144	2	1	5	11	10
38	Rhode Island	150	.....	1	.....	23	14	54	8	31	3	9	2	2	3	2.00 to 2.04	16	.....	.....	.....	.....	.....
39	South Carolina	75	21	16	12	11	2	6	.....	2	1	2	1	.....	1	1.25 to 1.29	3	.....	.....	.....	.....	.....
40	South Dakota	50	3	.....	10	6	5	6	3	5	.....	5	1	2	4	2.00 to 2.04	4	.....	.....	.....	.....	.....
41	Tennessee	148	8	28	26	40	13	9	9	4	9	1	1	.....	.....	1.50 to 1.54	14	.....	.....	1	.....	3
42	Texas	474	15	38	54	117	36	74	37	39	19	25	12	3	5	1.85 to 1.89	39	1	2	1	5	1
43	Utah	37	.....	8	.....	10	5	4	8	.....	2	.....	.....	.....	.....	1.75 to 1.79	3	.....	.....	.....	.....	.....
44	Vermont	108	1	10	11	36	8	25	8	5	1	.....	2	1	.....	1.65 to 1.69	15	.....	.....	.....	3	1
45	Virginia	71	6	15	12	17	7	8	4	2	.....	.....	.....	.....	.....	1.50 to 1.54	3	.....	.....	.....	1	.....
46	Washington	130	1	4	7	6	21	20	28	7	4	20	4	.....	8	2.30 to 2.34	16	.....	.....	.....	.....	1
47	West Virginia	97	3	10	13	29	7	18	9	4	3	.....	.....	.....	1	1.65 to 1.69	3	.....	.....	.....	.....	.....
48	Wisconsin	347	10	29	46	124	37	58	26	9	4	2	2	.....	.....	1.65 to 1.69	19	.....	.....	1	2	.....
49	Wyoming	34	.....	.....	.....	2	.....	8	7	7	4	1	4	.....	1	2.50 to 2.54	6	.....	.....	.....	.....	.....
50	All other states	98	.....	9	11	12	18	27	7	10	1	2	.....	.....	1	1.80 to 1.84	14	.....	1	5	.....	1

WITH MEDIAN WAGES—PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902.

FOREMEN AND INSPECTORS—continued.									ENGINEERS.																	
$2.00 to $2.24	$2.25 to $2.49	$2.50 to $2.74	$2.75 to $2.99	$3.00 to $3.24	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	Total.	Less than $1.00.	$1.00 to $1.24.	$1.25 to $1.49.	$1.50 to $1.74.	$1.75 to $1.99.	$2.00 to $2.24.	$2.25 to $2.49.	$2.50 to $2.74.	$2.75 to $2.99.	$3.00 to $3.24.	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	
223	137	202	93	191	123	85	107	2.50 to 2.54	3,604	34	152	365	657	354	724	286	382	166	203	97	58	126	2.00 to 2.04	1
.....	1	2	.....	.....	.....	.....	.....	1.75 to 1.79	15	.....	1	2	2	.....	1	3	2	.....	2	.....	2	.....	2.30 to 2.34	2
.....	.....	.....	1	.....	.....	1	.....	3.50 to 3.54	18	.....	.....	.....	.....	.....	2	.....	1	2	4	2	3	4	3.00 to 3.04	3
1	.....	.....	.....	.....	.....	1	.....	3.50 to 3.54	28	.....	.....	1	17	.....	5	2	3	.....	.....	.....	.....	.....	1.65 to 1.69	4
6	10	19	11	13	15	10	13	3.00 to 3.04	73	.....	.....	.....	1	3	7	3	23	9	9	5	9	4	2.65 to 2.69	5
2	1	4	3	3	6	6	6	3.25 to 3.29	56	.....	.....	.....	1	2	6	3	10	9	7	10	3	5	2.80 to 2.84	6
1	1	3	.....	.....	1	11	1	3.50 to 3.54	46	.....	.....	5	1	1	6	10	6	3	7	1	4	2	2.45 to 2.49	7
.....	.....	.....	.....	.....	2	.....	.....	1.50 to 1.54	19	.....	2	1	4	2	4	3	2	.....	.....	1	.....	.....	2.00 to 2.04	8
2	1	.....	1	.....	.....	.....	1	2.25 to 2.29	18	.....	2	5	5	.....	1	1	2	1	1	.....	.....	.....	1.65 to 1.69	9
.....	.....	1	.....	.....	6	1	1	3.25 to 3.29	14	.....	.....	.....	.....	.....	3	3	3	1	2	2	.....	.....	2.60 to 2.64	10
15	7	6	7	23	6	.....	2	2.10 to 2.14	370	3	27	51	84	51	76	18	33	11	7	8	1	.....	1.80 to 1.84	11
10	4	5	1	.....	1	.....	.....	2.00 to 2.04	136	.....	8	20	40	25	24	8	3	4	.....	2	1	1	1.75 to 1.79	12
.....	.....	1	.....	.....	.....	.....	.....	2.50 to 2.54	13	.....	.....	2	4	.....	3	1	2	.....	.....	1	.....	.....	2.00 to 2.04	13
1	6	1	.....	.....	.....	.....	.....	1.95 to 1.99	142	2	14	35	31	13	28	4	10	1	3	.....	.....	1	1.65 to 1.69	14
4	5	.....	2	1	1	.....	.....	2.25 to 2.29	55	.....	2	6	13	8	10	9	4	1	1	.....	1	.....	1.75 to 1.79	15
2	.....	3	.....	1	.....	.....	.....	2.50 to 2.54	53	.....	6	7	17	2	11	2	2	.....	3	.....	1	2	1.65 to 1.69	16
.....	.....	6	1	1	.....	2	.....	2.50 to 2.54	24	1	.....	.....	1	3	4	.....	4	.....	5	1	.....	5	2.65 to 2.69	17
4	2	3	2	3	.....	.....	1	2.50 to 2.54	19	.....	.....	1	1	3	4	6	3	.....	.....	.....	1	.....	2.25 to 2.29	18
1	15	.....	.....	1	1	.....	.....	2.25 to 2.29	33	.....	1	1	3	5	7	2	2	.....	12	.....	.....	.....	2.00 to 2.04	19
50	3	6	4	6	8	2	14	2.00 to 2.04	198	.....	.....	1	6	3	41	26	42	19	26	10	3	21	2.50 to 2.54	20
8	8	9	2	2	4	.....	.....	1.86 to 1.89	123	.....	5	19	25	9	30	18	6	1	2	3	1	4	2.00 to 2.04	21
1	3	5	2	1	2	1	.....	2.50 to 2.54	87	1	2	6	15	12	27	8	8	3	2	.....	.....	3	2.00 to 2.04	22
2	.....	1	1	1	.....	.....	.....	2.00 to 2.04	24	.....	.....	5	8	1	3	1	5	.....	1	.....	.....	.....	1.65 to 1.69	23
6	13	6	2	22	4	10	8	3.00 to 3.04	100	.....	9	20	19	4	12	9	12	3	4	4	.....	4	1.95 to 1.99	24
.....	.....	1	3	4	.....	1	8	3.50 to 3.54	25	.....	.....	.....	.....	1	.....	2	.....	1	5	1	2	13	4.00 to 4.04	25
2	.....	2	.....	3	.....	.....	.....	2.50 to 2.54	41	.....	1	3	6	13	9	2	1	.....	5	.....	.....	1	1.95 to 1.99	26
.....	.....	.....	.....	1	1	.....	.....	3.25 to 3.29	2	.....	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	2.40 to 2.44	27
4	3	3	1	2	1	.....	.....	2.50 to 2.54	22	.....	.....	.....	.....	1	4	9	2	3	.....	2	.....	1	2.10 to 2.14	28
7	9	15	3	6	.....	5	3	2.40 to 2.44	136	.....	.....	.....	2	18	24	27	15	12	20	5	4	3	6	2.20 to 2.24	29
.....	.....	.....	1	.....	1	.....	.....	3.25 to 3.29	11	.....	.....	1	.....	.....	.....	2	.....	5	.....	1	1	1	.....	2.50 to 2.54	30
19	9	29	23	58	37	24	26	3.00 to 3.04	448	6	10	26	83	26	65	22	62	39	44	14	20	31	2.30 to 2.34	31
.....	.....	.....	.....	1	1	.....	.....	3.25 to 3.29	14	2	3	4	1	.....	1	1	.....	1	.....	1	.....	.....	1.25 to 1.29	32
.....	.....	.....	.....	.....	.....	.....	.....	.....	14	.....	.....	.....	1	1	3	2	6	1	.....	.....	.....	.....	2.25 to 2.29	33
20	.....	11	4	10	1	1	.....	2.00 to 2.04	215	3	3	25	49	13	57	17	20	5	14	7	1	1	2.00 to 2.04	34
1	.....	.....	.....	.....	1	.....	.....	3.25 to 3.29	12	.....	.....	1	5	.....	.....	3	1	2	.....	.....	.....	.....	2.25 to 2.29	35
4	.....	1	1	.....	5	.....	.....	2.95 to 2.99	39	.....	.....	1	6	2	10	1	2	.....	14	2	.....	1	2.30 to 2.34	36
29	11	30	7	15	8	6	9	2.50 to 2.54	464	6	19	42	77	78	139	28	40	12	8	8	1	6	2.00 to 2.04	37
1	1	3	1	5	2	1	2	3.00 to 3.04	24	.....	.....	.....	.....	2	7	7	.....	7	.....	.....	.....	1	2.00 to 2.04	38
1	.....	.....	1	.....	.....	.....	1	2.75 to 2.79	18	.....	5	4	2	2	2	.....	1	.....	1	1	.....	.....	1.50 to 1.54	39
1	.....	.....	.....	1	.....	.....	2	4.00 to 4.04	21	2	.....	1	6	4	2	2	1	.....	1	.....	.....	2	1.95 to 1.99	40
.....	5	3	1	1	.....	.....	.....	2.45 to 2.49	35	1	10	9	4	2	4	.....	1	3	.....	1	.....	.....	1.30 to 1.34	41
5	5	9	2	4	2	1	1	2.45 to 2.49	160	6	11	21	42	10	18	15	20	6	2	5	.....	4	1.80 to 1.84	42
1	1	.....	1	.....	.....	.....	.....	2.25 to 2.29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	43
4	.....	4	1	.....	1	1	.....	2.15 to 2.19	15	.....	.....	1	4	1	6	2	.....	.....	.....	1	.....	.....	2.00 to 2.04	44
1	.....	1	.....	.....	.....	.....	.....	2.15 to 2.19	24	.....	3	9	3	2	3	3	1	.....	.....	.....	.....	.....	1.50 to 1.54	45
1	2	1	2	1	2	.....	6	3.25 to 3.29	30	.....	1	2	2	3	4	11	3	1	1	.....	.....	2	2.25 to 2.29	46
.....	1	1	.....	.....	.....	.....	1	2.65 to 2.69	46	.....	.....	9	15	2	11	6	2	1	.....	.....	.....	.....	1.65 to 1.69	47
4	9	2	.....	.....	1	.....	.....	2.25 to 2.29	103	1	6	15	30	12	25	9	.....	3	2	.....	.....	.....	1.70 to 1.74	48
.....	.....	2	1	.....	2	.....	1	3.25 to 3.29	10	.....	.....	.....	.....	.....	3	1	3	2	.....	1	.....	.....	2.50 to 2.54	49
2	1	3	.....	1	.....	.....	.....	2.00 to 2.04	11	.....	.....	2	2	.....	1	1	3	1	.....	.....	.....	1	2.25 to 2.29	50

TABLE 95.—NUMBER OF WAGE-EARNERS AT SPECIFIED DAILY RATES OF PAY, WITH

	STATE OR TERRITORY.	FIREMEN.														DYNAMO AND SWITCHBOARD MEN.						
		Total.	Less than $1.00	$1.00 to $1.24	$1.25 to $1.49	$1.50 to $1.74	$1.75 to $1.99	$2.00 to $2.24	$2.25 to $2.49	$2.50 to $2.74	$2.75 to $2.99	$3.00 to $3.24	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	Total.	Less than $1.00	$1.00 to $1.24	$1.25 to $1.49	$1.50 to $1.74	$1.75 to $1.99
1	United States...	2,854	99	261	364	623	418	513	287	128	122	32	3	2	2	1.75 to 1.79	1,787	19	96	126	328	245
2	Alabama	17	1	10	4	2										1.15 to 1.19	3					
3	Arizona	12				3	3	2	1	1					2	2.00 to 2.04	7					
4	Arkansas	16		5	6	4		1								1.30 to 1.34	7		2	1	1	
5	California	55		1		5	3	13	11	22						2.25 to 2.29	190			6	5	28
6	Colorado	59		1		4		38	5	6	3	2				2.00 to 2.04	35			2	2	
7	Connecticut	32		2		2	6	20	2							2.00 to 2.04	30		1		4	
8	Florida	14	1	3	8	1	1									1.25 to 1.29	1	1				
9	Georgia	21	8	10		3										1.00 to 1.04	8		1	6		
10	Idaho	3					1	2								2.00 to 2.04	8				2	
11	Illinois	236	10	39	44	38	49	46	5	4	1					1.60 to 1.64	96	2	7	6	16	16
12	Indiana	79	7	13	21	27	8	3								1.45 to 1.49	23	1		3	7	5
13	Indian Territory	5			1	4										1.50 to 1.54						
14	Iowa	101	10	24	39	21	2	5								1.30 to 1.34	14		1	3	8	2
15	Kansas	33	1	8	4	8	10	7								1.75 to 1.79	7		1	1	3	
16	Kentucky	36		19	5	3	5	4								1.15 to 1.19	9				6	
17	Louisiana	23		1	1	5	5	10	1							1.75 to 1.79	21		1	2	9	4
18	Maine	20		2		8	8	2								1.65 to 1.69	57		1	8	9	18
19	Maryland	38	1	3	3	5	1	25								2.00 to 2.04	23				23	
20	Massachusetts	157			3	19	28	67	16	24						2.00 to 2.04	132	1		2	20	15
21	Michigan	92	3	5	26	27	17	12		2						1.50 to 1.54	70	3	9	12	21	
22	Minnesota	44	1	3	9	8	11	6	6							1.75 to 1.79	30		1	1	8	6
23	Mississippi	28	2	6	15	5										1.25 to 1.29	4		1		1	
24	Missouri	114	8	11	14	35	29	9	2	2	4					1.50 to 1.54	29		2		3	13
25	Montana	9				2		1				4		2		3.00 to 3.04	29					
26	Nebraska	21			5	2	9	3	2							1.75 to 1.79	16	1	1	3	1	2
27	Nevada																4					
28	New Hampshire	16			3	4	3	4	2							1.80 to 1.84	52		1	5	16	16
29	New Jersey	103	1	3	9	13	29	20	26	2						1.85 to 1.89	56		4	1	11	10
30	New Mexico	6				1		4	1							2.00 to 2.04	1					
31	New York	556	2	8	30	85	47	43	153	54	112	22				2.25 to 2.29	411	2	13	32	49	32
32	North Carolina	8	4	4												1.00 to 1.04	8		3	1	3	
33	North Dakota	7					2	2	3							2.00 to 2.04						
34	Ohio	159	3	13	22	65	22	21	8	1		4				1.50 to 1.54	53		4	3	12	26
35	Oklahoma	8			2	6										1.50 to 1.54						
36	Oregon	20	1	4	2	1	2		9	1						1.75 to 1.79	18		1	2		
37	Pennsylvania	377	3	24	44	99	90	94	17	6						1.75 to 1.79	137	3	18	10	29	15
38	Rhode Island	18				5		12		1						2.00 to 2.04	19		1		2	5
39	South Carolina	20	14	5	1											Less than 1.00	13	2	1	1	6	
40	South Dakota	8	1		5					1			1			1.45 to 1.49	5					1
41	Tennessee	32	6	4	7	15										1.30 to 1.34	13		2		7	
42	Texas	90	5	11	11	31	11	10	7	1	2		1			1.65 to 1.69	24		2	3	9	6
43	Utah																18		7		5	5
44	Vermont	12		1	2	8	1									1.50 to 1.54	35	1	6	5	13	3
45	Virginia	14	3	5	2	4										1.20 to 1.24	4	1			2	1
46	Washington	22		1	4	3	3	5	6							2.00 to 2.04	19	1	1		1	7
47	West Virginia	18	1	4	1	7	5									1.50 to 1.54	1		1			
48	Wisconsin	67	2	12	9	30	5	6	2				1			1.50 to 1.54	34		2	7	12	6
49	Wyoming	7				2		3	2							2.00 to 2.04	3					
50	All other states	21		1	2	3	2	13								2.00 to 2.04	10				2	3

MEDIAN WAGES—PRIVATE STATIONS, BY STATES AND TERRITORIES: 1902—Continued.

DYNAMO AND SWITCHBOARD MEN—continued.									LINEMEN, MECHANICS, AND LAMP TRIMMERS.															
$2.00 to $2.24	$2.25 to $2.49	$2.50 to $2.74	$2.75 to $2.99	$3.00 to $3.24	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	Total.	Less than $1.00	$1.00 to $1.24	$1.25 to $1.49	$1.50 to $1.74	$1.75 to $1.99	$2.00 to $2.24	$2.25 to $2.49	$2.50 to $2.74	$2.75 to $2.99	$3.00 to $3.24	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	
407	251	176	54	52	20	4	9	2.00 to 2.04	7,035	89	261	420	1,230	965	1,804	643	845	359	320	41	40	18	2.00 to 2.04	1
2	.....	1	.....	.....	.....	.....	.....	2.00 to 2.04	38	1	7	11	15	.....	3	.....	1	.....	.....	.....	.....	.....	1.50 to 1.54	2
.....	7	.....	.....	.....	.....	.....	.....	2.30 to 2.34	15	1	.....	.....	.....	.....	3	.....	2	1	3	.....	5	.....	3.00 to 3.04	3
.....	.....	3	.....	.....	.....	.....	.....	1.65 to 1.69	22	1	4	3	7	1	4	1	.....	.....	1	.....	.....	.....	1.65 to 1.69	4
28	56	31	14	10	6	2	4	2.25 to 2.29	289	.....	3	4	6	6	48	46	77	44	44	4	6	1	2.50 to 2.54	5
13	.....	14	1	.....	8	.....	.....	2.50 to 2.54	129	.....	2	2	2	3	39	14	13	12	31	2	7	2	2.50 to 2.54	6
15	3	2	.....	3	2	.....	.....	2.00 to 2.04	105	.....	.....	3	14	6	40	2	33	4	3	.....	.....	.....	2.00 to 2.04	7
.....	.....	.....	.....	.....	.....	.....	.....	Less than 1.00	12	2	2	2	3	.....	2	1	.....	.....	.....	.....	.....	.....	1.50 to 1.54	8
1	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	23	3	11	4	2	1	2	.....	.....	.....	.....	.....	.....	.....	1.15 to 1.19	9
.....	1	.....	5	.....	.....	.....	.....	2.80 to 2.84	23	.....	.....	1	1	.....	2	.....	.....	5	8	6	.....	.....	3.00 to 3.04	10
19	22	2	2	4	.....	.....	.....	2.00 to 2.04	479	9	32	42	63	122	127	11	30	16	26	1	.....	.....	1.75 to 1.79	11
5	.....	1	.....	1	.....	.....	.....	1.75 to 1.79	153	.....	10	28	37	25	29	7	13	3	1	.....	.....	.....	1.75 to 1.79	12
.....	.....	.....	.....	.....	.....	.....	.....	.....	10	.....	1	1	7	.....	1	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	13
.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	99	2	6	26	26	11	6	21	1	.....	.....	.....	.....	.....	1.60 to 1.64	14
2	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	65	2	4	6	15	12	10	14	1	1	.....	.....	.....	.....	1.75 to 1.79	15
3	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	65	3	12	5	7	1	23	4	10	.....	.....	.....	.....	.....	2.00 to 2.04	16
1	.....	2	1	.....	.....	1	.....	1.50 to 1.54	83	.....	1	.....	43	7	3	.....	26	1	1	1	.....	.....	1.70 to 1.74	17
16	.....	3	2	.....	.....	.....	.....	1.80 to 1.84	75	2	1	3	20	8	24	6	10	.....	.....	1	.....	.....	2.00 to 2.04	18
.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	87	1	.....	2	38	2	2	2	40	.....	.....	.....	.....	.....	2.00 to 2.04	19
38	7	44	.....	4	1	.....	.....	2.10 to 2.14	429	1	3	6	68	56	83	59	109	27	10	1	.....	6	2.15 to 2.19	20
17	3	1	3	1	.....	.....	.....	1.65 to 1.69	178	3	14	20	45	17	31	17	25	5	.....	.....	1	.....	1.80 to 1.84	21
8	4	2	.....	.....	.....	.....	.....	1.80 to 1.84	133	1	2	10	22	15	29	23	28	1	.....	2	.....	.....	2.00 to 2.04	22
.....	2	.....	.....	.....	.....	.....	.....	1.65 to 1.69	22	5	4	2	9	.....	1	.....	.....	1	.....	.....	.....	.....	1.50 to 1.54	23
6	3	1	.....	.....	1	.....	.....	1.90 to 1.94	233	4	5	17	23	21	64	13	27	25	29	.....	4	1	2.00 to 2.04	24
.....	4	8	.....	11	4	.....	2	3.00 to 3.04	33	.....	.....	.....	1	1	2	.....	5	4	7	2	7	4	3.00 to 3.04	25
1	2	3	.....	2	.....	.....	.....	1.95 to 1.99	53	1	1	6	13	12	1	2	7	6	2	2	.....	.....	1.75 to 1.79	26
1	.....	1	.....	2	.....	.....	.....	2.60 to 2.64	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	27
11	1	1	.....	1	.....	.....	.....	1.75 to 1.79	70	2	.....	2	15	18	17	8	7	1	.....	.....	.....	.....	1.85 to 1.89	28
15	7	6	1	.....	.....	1	.....	2.00 to 2.04	333	2	.....	16	47	54	98	28	32	44	8	1	1	1	2.00 to 2.04	29
.....	.....	.....	.....	.....	1	.....	.....	3.25 to 3.29	6	.....	1	.....	.....	.....	3	.....	2	.....	1	.....	.....	.....	2.50 to 2.54	30
147	88	28	14	2	1	.....	3	2.00 to 2.04	1,702	7	20	42	187	308	637	185	170	82	56	5	3	.....	2.00 to 2.04	31
.....	1	.....	.....	.....	.....	.....	.....	1.50 to 1.54	10	1	4	.....	2	3	.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	32
.....	.....	.....	.....	.....	.....	.....	.....	.....	9	.....	1	1	1	2	3	.....	1	.....	.....	.....	.....	.....	1.75 to 1.79	33
3	3	2	.....	.....	.....	.....	.....	1.75 to 1.79	402	9	13	27	115	43	133	16	32	5	3	5	1	.....	1.90 to 1.94	34
.....	.....	.....	.....	.....	.....	.....	.....	.....	13	.....	2	3	3	.....	4	1	.....	.....	.....	.....	.....	.....	1.65 to 1.69	35
6	9	.....	.....	.....	.....	.....	.....	2.05 to 2.09	37	.....	1	1	1	1	19	1	2	4	7	.....	.....	.....	2.00 to 2.04	36
17	18	15	8	4	.....	.....	.....	1.75 to 1.79	959	6	32	62	229	152	182	109	95	48	39	2	.....	3	1.90 to 1.94	37
4	3	3	1	.....	.....	.....	.....	2.00 to 2.04	73	.....	.....	.....	14	2	30	4	17	1	4	.....	1	.....	2.00 to 2.04	38
1	.....	1	.....	1	.....	.....	.....	1.65 to 1.69	21	5	5	6	3	.....	2	.....	.....	.....	.....	.....	.....	.....	1.25 to 1.29	39
2	.....	.....	.....	2	.....	.....	.....	2.00 to 2.04	12	.....	.....	4	.....	.....	1	1	3	.....	1	.....	2	.....	2.50 to 2.54	40
2	.....	.....	2	.....	.....	.....	.....	1.50 to 1.54	54	1	12	9	14	8	3	4	.....	3	.....	.....	.....	.....	1.50 to 1.54	41
4	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	161	3	12	18	30	8	37	10	9	9	19	4	2	.....	2.00 to 2.04	42
1	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	16	.....	1	.....	5	.....	2	7	.....	1	.....	.....	.....	.....	2.30 to 2.34	43
6	1	.....	.....	.....	.....	.....	.....	1.50 to 1.54	31	.....	3	3	8	2	9	5	1	.....	.....	.....	.....	.....	1.90 to 1.94	44
.....	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	26	2	7	1	7	4	4	1	.....	.....	.....	.....	.....	.....	1.65 to 1.69	45
2	2	.....	.....	4	1	.....	.....	1.95 to 1.99	43	.....	1	1	.....	7	8	7	3	1	14	1	.....	.....	2.45 to 2.49	46
.....	.....	.....	.....	.....	.....	.....	.....	1.00 to 1.04	29	2	5	3	7	.....	7	2	1	2	.....	.....	.....	.....	1.50 to 1.54	47
5	1	1	.....	.....	.....	.....	.....	1.60 to 1.64	124	7	9	14	50	14	18	5	6	1	.....	.....	.....	.....	1.65 to 1.69	48
.....	3	.....	.....	.....	.....	.....	.....	2.45 to 2.49	8	.....	.....	.....	.....	.....	2	1	2	1	1	1	.....	.....	2.65 to 2.69	49
5	.....	.....	.....	.....	.....	.....	.....	1.75 to 1.79	42	.....	7	2	5	12	6	5	4	.....	1	.....	.....	.....	1.75 to 1.79	50

TABLE 96.—NUMBER OF WAGE-EARNERS AT SPECIFIED DAILY RATES OF PAY, WITH

	STATE OR TERRITORY.	ALL CLASSES.														FOREMEN AND INSPECTORS.						
		Total.	Less than $1.00	$1.00 to $1.24	$1.25 to $1.49.	$1.50 to $1.74.	$1.75 to $1.99.	$2.00 to $2.24.	$2.25 to $2.49.	$2.50 to $2.74.	$2.75 to $2.99	$3.00 to $3.24	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	Total.	Less than $1.00	$1.00 to $1.24	$1.25 to $1.49	$1.50 to $1.74	$1.75 to $1.99
1	United States...	2,157	105	201	294	440	233	418	203	166	29	34	25	2	7	1.75 to 1.79	74	1	1	4	7	5
2	Alabama	10	1	5	2	1		1								1.20 to 1.24						
3	Arkansas	11		1	1	3		3			2	1				2.00 to 2.04						
4	California	30	1	2		1		10	5	7	1	2			1	2.25 to 2.29	2					
5	Colorado	1									1					2.75 to 2.79						
6	Connecticut	6				4	1		1							1.60 to 1.64	1					1
7	Delaware	15		3	5	1		3		2		1				1.30 to 1.34						
8	Florida	28		3	4	8	5		1	6			1			1.60 to 1.64	1					
9	Georgia	42	12	9	10	6	1	3	1							1.25 to 1.29						
10	Idaho	2						1					1			3.25 to 3.29						
11	Illinois	310	1	27	26	23	28	68	78	33	6	7	9	1	3	2.10 to 2.14	16		1	1	2	
12	Indiana	142	1	6	37	36	36	19	2	3	1		1			1.60 to 1.64	2					1
13	Iowa	75	6	13	18	23	6	5	4							1.50 to 1.54						
14	Kansas	24		3		5	1	10	1	3		1				2.00 to 2.04	1					
15	Kentucky	30		6	8	7	4	2	1	2						1.50 to 1.54	1				1	
16	Louisiana	19	1	1	4	4	3		3	3						1.65 to 1.69	1					
17	Maine	6			1		4	1								1.85 to 1.89	1					
18	Maryland	19		2	1	5	5	3		2		1				1.75 to 1.79						
19	Massachusetts	84		1	2	4	7	33	14	15	3	5				2.10 to 2.14	2					
20	Michigan	254	5	23	26	62	42	58	9	15	7	3	3		1	1.75 to 1.79	12			1	1	1
21	Minnesota	118	5	8	14	17	16	26	12	17	2	1				1.95 to 1.99	1					
22	Mississippi	43	4	7	10	7	1	1	3	8	1	1				1.50 to 1.54	3					
23	Missouri	86	4	11	16	21	5	20	3	1		3	2			1.65 to 1.69	5				1	1
24	Montana	3				2	1									1.50 to 1.54						
25	Nebraska	26	2	5	4	3	5	4				2		1		1.60 to 1.64						
26	New Hampshire	1				1										1.65 to 1.69						
27	New Jersey	12		2	2	3	1	1		2		1				1.70 to 1.74						
28	New York	88	1	4	7	31	8	25	2	10						1.80 to 1.84	2					
29	North Carolina	32	10	9	6	3	3	1								1.00 to 1.04						
30	North Dakota	14					1	8	2	2		1				2.00 to 2.04						
31	Ohio	249	18	16	38	76	19	58	4	11	3	2	4			1.65 to 1.69	3	1		1		
32	Oklahoma	5				3			2							1.65 to 1.69						
33	Oregon	5			1	2		1	1							1.65 to 1.69	1					
34	Pennsylvania	120	3	5	15	31	6	17	40		1		1		1	2.00 to 2.04	5					
35	Rhode Island	2			1			1								2.00 to 2.04						
36	South Carolina	30	14	7	3	5				1						1.00 to 1.04	1				1	
37	South Dakota	9	2		3	3			1							1.45 to 1.49						
38	Tennessee	40	1	6	9	5	2	9	2	2	1	1	2			1.65 to 1.69	3					
39	Texas	31	1			8	4	9	7			1	1			2.00 to 2.04	3					1
40	Utah	1				1										1.70 to 1.74						
41	Vermont	18	1	3	6	3	4	1								1.30 to 1.34	1			1		
42	Virginia	26	6	4	5	4	5	1	1							1.30 to 1.34	1					
43	Washington	31				1	4	7		19						2.50 to 2.54	3					
44	West Virginia	24	2	3		11	1	4	1	2						1.65 to 1.69	2				1	
45	Wisconsin	35	3	6	9	6	4	4	2						1	1.45 to 1.49						

MEDIAN RATE—MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902.

FOREMEN AND INSPECTORS—continued.									ENGINEERS.															
$2.00 to $2.24	$2.25 to $2.49	$2.50 to $2.74	$2.75 to $2.99	$3.00 to $3.24	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	Total.	Less than $1.00.	$1.00 to $1.24.	$1.25 to $1.49.	$1.50 to $1.74.	$1.75 to $1.99.	$2.00 to $2.24.	$2.25 to $2.49.	$2.50 to $2.74.	$2.75 to $2.99.	$3.00 to $3.24.	$3.25 to $3.49.	$3.50 to $3.74.	$3.75 and over.	Median rate (dollars).	
12	12	17	3	6	3	.....	3	2.30 to 2.34	805	8	59	104	168	84	168	65	90	15	23	18	.....	3	1.95 to 1.99	1
.....	.....	.....	.....	.....	.....	.....	.....	.....	5	.....	1	2	1	.....	1	.....	.....	.....	.....	.....	.....	.....	1.25 to 1.29	2
.....	.....	.....	.....	.....	.....	.....	.....	.....	5	.....	.....	.....	3	.....	.....	.....	.....	1	1	.....	.....	.....	1.65 to 1.69	3
.....	.....	2	.....	.....	.....	.....	.....	2.65 to 2.69	11	.....	1	.....	1	.....	1	3	2	1	1	.....	.....	1	2.25 to 2.29	4
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	2.75 to 2.79	5
.....	.....	.....	.....	.....	.....	.....	.....	1.95 to 1.99	1	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	2.45 to 2.49	6
.....	.....	.....	.....	.....	.....	.....	.....	.....	11	.....	.....	4	1	.....	3	.....	2	.....	1	.....	.....	.....	2.00 to 2.04	7
.....	.....	1	.....	.....	.....	.....	.....	2.50 to 2.54	7	.....	.....	1	.....	1	.....	.....	5	.....	.....	.....	.....	.....	2.50 to 2.54	8
.....	.....	.....	.....	.....	.....	.....	.....	.....	18	.....	3	9	2	1	2	1	.....	.....	.....	.....	.....	.....	1.30 to 1.34	9
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	3.25 to 3.29	10
1	4	3	.....	1	2	.....	1	2.45 to 2.49	94	.....	5	12	11	10	17	9	14	3	4	7	.....	2	2.00 to 2.04	11
1	.....	.....	.....	.....	.....	.....	.....	2.10 to 2.14	61	.....	1	13	17	15	11	2	2	.....	.....	.....	.....	.....	1.65 to 1.69	12
.....	.....	.....	.....	.....	.....	.....	.....	.....	36	1	3	5	14	4	5	4	.....	.....	.....	.....	.....	.....	1.60 to 1.64	13
1	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	9	.....	.....	.....	4	.....	2	.....	2	.....	1	.....	.....	.....	2.00 to 2.04	14
.....	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	10	.....	2	.....	.....	3	2	1	2	.....	.....	.....	.....	.....	2.00 to 2.04	15
.....	.....	1	.....	.....	.....	.....	.....	2.50 to 2.54	7	.....	.....	.....	3	1	.....	3	.....	.....	.....	.....	.....	.....	1.95 to 1.99	16
1	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	17
.....	.....	.....	.....	.....	.....	.....	.....	.....	7	.....	.....	.....	2	.....	2	.....	2	.....	1	.....	.....	.....	2.00 to 2.04	18
.....	.....	1	1	.....	.....	.....	.....	2.75 to 2.79	24	.....	.....	.....	.....	.....	8	3	8	1	4	.....	.....	.....	2.50 to 2.54	19
1	2	2	2	1	.....	.....	1	2.50 to 2.54	86	3	11	8	24	6	19	5	6	1	2	1	.....	.....	1.65 to 1.69	20
.....	.....	.....	.....	1	.....	.....	.....	3.00 to 3.04	69	.....	2	5	8	7	19	10	16	2	.....	.....	.....	.....	2.00 to 2.04	21
.....	.....	2	.....	1	.....	.....	.....	2.50 to 2.54	14	.....	1	1	4	1	1	1	4	1	.....	.....	.....	.....	2.00 to 2.04	22
2	.....	.....	.....	1	.....	.....	.....	2.00 to 2.04	35	.....	5	6	7	4	6	2	1	.....	2	2	.....	.....	1.65 to 1.69	23
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1.80 to 1.84	24
.....	.....	.....	.....	.....	.....	.....	.....	.....	7	.....	2	.....	1	2	1	.....	.....	.....	1	.....	.....	.....	1.75 to 1.79	25
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26
.....	.....	.....	.....	.....	.....	.....	.....	.....	4	.....	.....	1	.....	.....	1	.....	1	.....	1	.....	.....	.....	2.60 to 2.64	27
.....	.....	2	.....	.....	.....	.....	.....	2.60 to 2.64	31	.....	2	.....	2	7	11	2	7	.....	.....	.....	.....	.....	2.00 to 2.04	28
.....	.....	.....	.....	.....	.....	.....	.....	.....	10	.....	1	6	1	2	.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	29
.....	.....	.....	.....	.....	.....	.....	.....	.....	7	.....	.....	.....	.....	.....	3	1	2	.....	1	.....	.....	.....	2.25 to 2.29	30
1	.....	.....	.....	.....	.....	.....	.....	1.25 to 1.29	119	2	12	11	36	5	31	4	9	3	2	4	.....	.....	1.65 to 1.69	31
.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	2.25 to 2.29	32
1	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	2	.....	.....	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	2.30 to 2.34	33
.....	4	.....	.....	.....	.....	.....	1	2.25 to 2.29	38	.....	1	6	11	3	11	4	.....	1	.....	1	.....	.....	1.90 to 1.94	34
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	35
.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	8	.....	1	2	4	.....	.....	.....	1	.....	.....	.....	.....	.....	1.50 to 1.54	36
.....	.....	.....	.....	.....	.....	.....	.....	.....	6	.....	.....	3	2	.....	.....	1	.....	.....	.....	.....	.....	.....	1.60 to 1.64	37
2	.....	.....	.....	1	.....	.....	.....	2.00 to 2.04	13	.....	.....	2	2	.....	3	2	2	.....	.....	2	.....	.....	2.15 to 2.19	38
1	.....	.....	.....	.....	1	.....	.....	2.00 to 2.04	8	1	.....	.....	1	3	.....	2	.....	.....	1	.....	.....	.....	1.80 to 1.84	39
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
.....	.....	.....	.....	.....	.....	.....	.....	1.25 to 1.29	2	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	41
.....	1	.....	.....	.....	.....	.....	.....	2.30 to 2.34	9	.....	2	2	2	2	1	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	42
.....	.....	3	.....	.....	.....	.....	.....	2.50 to 2.54	3	.....	.....	.....	.....	2	1	.....	.....	.....	.....	.....	.....	.....	1.95 to 1.99	43
.....	1	.....	.....	.....	.....	.....	.....	2.45 to 2.49	7	1	2	.....	1	.....	1	.....	2	.....	.....	.....	.....	.....	1.65 to 1.69	44
.....	.....	.....	.....	.....	.....	.....	.....	.....	15	.....	1	4	2	3	3	2	.....	.....	.....	.....	.....	.....	1.80 to 1.84	45

TABLE 96.—NUMBER OF WAGE-EARNERS AT SPECIFIED DAILY RATES OF PAY, WITH

	STATE OR TERRITORY.	FIREMEN.														DYNAMO AND SWITCHBOARD MEN.						
		Total.	Less than $1.00	$1.00 to $1.24	$1.25 to $1.49.	$1.50 to $1.74.	$1.75 to $1.99.	$2.00 to $2.24.	$2.25 to $2.49.	$2.50 to $2.74.	$2.75 to $2.99	$3.00 to $3.24	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	Total.	Less than $1.00	$1.00 to $1.24	$1.25 to $1.49	$1.50 to $1.74	$1.75 to $1.99
1	United States...	486	51	73	108	117	54	74	8	.....	.....	1	.....	.....	.....	1.50 to 1.54	101	3	9	12	20	18
2	Alabama	4	1	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.00 to 1.04	.....	.....	.....	.....	.....	.....
3	Arkansas	4	.....	1	1	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	1	.....	.....	.....	.....	.....
4	California	3	1	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	7	.....	.....	.....	.....	.....
5	Colorado	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	Connecticut	2	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.60 to 1.64	.....	.....	.....	.....	.....	.....
7	Delaware	3	.....	2	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.10 to 1.14	1	.....	1	.....	.....	.....
8	Florida	6	.....	2	3	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.25 to 1.29	3	.....	.....	.....	3	.....
9	Georgia	11	7	3	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Less than 1.00	.....	.....	.....	.....	.....	.....
10	Idaho	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....
11	Illinois	72	1	12	10	8	11	30	.....	.....	.....	.....	.....	.....	.....	1.75 to 1.79	10	.....	.....	.....	.....	1
12	Indiana	26	.....	2	8	8	8	.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	1	.....	.....	1	.....	.....
13	Iowa	26	4	5	11	5	1	.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	.....	.....	.....	.....	.....	.....
14	Kansas	4	.....	1	.....	1	1	1	.....	.....	.....	.....	.....	.....	.....	1.75 to 1.79	1	.....	.....	.....	.....	.....
15	Kentucky	10	.....	4	4	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	1	.....	.....	1	.....	.....
16	Louisiana	5	1	1	2	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1.25 to 1.29	1	.....	.....	.....	.....	.....
17	Maine	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....
18	Maryland	5	.....	1	1	.....	3	.....	.....	.....	.....	.....	.....	.....	.....	1.75 to 1.79	.....	.....	.....	.....	.....	.....
19	Massachusetts	21	.....	.....	2	1	2	16	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	4	.....	.....	.....	.....	1
20	Michigan	38	.....	2	9	15	9	3	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	22	.....	3	2	4	12
21	Minnesota	30	4	6	4	7	5	3	1	.....	.....	.....	.....	.....	.....	1.50 to 1.54	.....	.....	.....	.....	.....	.....
22	Mississippi	17	3	2	8	3	.....	.....	1	.....	.....	.....	.....	.....	.....	1.25 to 1.29	.....	.....	.....	.....	.....	.....
23	Missouri	24	3	6	7	7	.....	1	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	1	.....	.....	.....	.....	.....
24	Montana	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	.....	.....	.....	.....	.....	.....
25	Nebraska	8	1	1	3	.....	1	1	.....	.....	.....	1	.....	.....	.....	1.45 to 1.49	2	.....	.....	.....	2	.....
26	New Hampshire	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1	.....
27	New Jersey	4	.....	1	1	1	1	.....	.....	.....	.....	.....	.....	.....	.....	1.70 to 1.74	.....	.....	.....	.....	.....	.....
28	New York	24	1	.....	5	17	.....	1	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	5	.....	.....	1	2	1
29	North Carolina	9	3	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.00 to 1.04	2	.....	1	.....	.....	.....
30	North Dakota	4	.....	.....	.....	.....	1	3	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	1	.....	.....	.....	.....	.....
31	Ohio	56	8	1	16	18	6	7	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	.....	.....	.....	.....	.....	.....
32	Oklahoma	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	.....	.....	.....	.....	.....	.....
33	Oregon	2	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	.....	.....	.....	.....	.....	.....
34	Pennsylvania	23	1	1	5	7	1	2	6	.....	.....	.....	.....	.....	.....	1.65 to 1.69	7	1	.....	.....	.....	1
35	Rhode Island	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
36	South Carolina	9	6	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Less than 1.00	1	.....	.....	1	.....	.....
37	South Dakota	1	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Less than 1.00	.....	.....	.....	.....	.....	.....
38	Tennessee	8	.....	3	3	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	5	.....	1	.....	1	.....
39	Texas	5	.....	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	2	.....	.....	.....	2	.....
40	Utah	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1	.....
41	Vermont	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	11	1	3	2	3	2
42	Virginia	6	4	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	Less than 1.00	2	.....	.....	1	1	.....
43	Washington	3	.....	.....	.....	1	1	1	.....	.....	.....	.....	.....	.....	.....	1.95 to 1.99	.....	.....	.....	.....	.....	.....
44	West Virginia	2	.....	.....	.....	.....	1	1	.....	.....	.....	.....	.....	.....	.....	2.15 to 2.19	2	.....	.....	.....	.....	.....
45	Wisconsin	9	1	3	3	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	4	1	.....	2	.....	.....

MEDIAN RATE—MUNICIPAL STATIONS, BY STATES AND TERRITORIES: 1902—Continued.

DYNAMO AND SWITCHBOARD MEN—continued.									LINEMEN, MECHANICS, AND LAMP TRIMMERS.														
$2.00 to $2.24	$2.25 to $2.49	$2.50 to $2.74	$2.75 to $2.99	$3.00 to $3.24	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	Total.	Less than $1.00.	$1.00 to $1.24.	$1.25 to $1.49.	$1.50 to $1.74.	$1.75 to $1.99.	$2.00 to $2.24.	$2.25 to $2.49.	$2.50 to $2.74.	$2.75 to $2.99.	$3.00 to $3.24.	$3.25 to $3.49	$3.50 to $3.74	$3.75 and over.	Median rate (dollars).	
16	13	4	2	4	.....	.....	.....	1.75 to 1.79	691	42	59	66	128	72	148	105	55	9	.....	4	2	1	2.00 to 2.04	1
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.00 to 1.04	2
.....	.....	.....	1	.....	.....	.....	.....	2.80 to 2.84	1	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	2.20 to 2.24	3
5	.....	1	.....	1	.....	.....	.....	2.00 to 2.04	7	.....	1	.....	.....	.....	2	2	2	.....	.....	.....	.....	.....	2.25 to 2.29	4
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	5
.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.60 to 1.64	6
.....	.....	.....	.....	.....	.....	.....	.....	1.00 to 1.04	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7
.....	.....	.....	.....	.....	.....	.....	.....	1.60 to 1.64	11	.....	1	.....	4	4	.....	1	.....	.....	.....	1	.....	.....	1.75 to 1.79	8
.....	.....	.....	.....	.....	.....	.....	.....	.....	13	5	3	.....	4	.....	1	.....	.....	.....	.....	.....	.....	.....	1.15 to 1.19	9
1	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	10
1	5	1	.....	2	.....	.....	.....	2.45 to 2.49	118	.....	9	3	2	6	19	60	15	3	.....	.....	1	.....	2.25 to 2.29	11
.....	.....	.....	.....	.....	.....	.....	.....	1.25 to 1.29	52	1	3	15	11	12	7	.....	1	1	.....	1	.....	.....	1.60 to 1.64	12
.....	.....	.....	.....	.....	.....	.....	.....	.....	13	1	5	2	4	1	.....	.....	.....	.....	.....	.....	.....	.....	1.45 to 1.49	13
.....	.....	1	.....	.....	.....	.....	.....	2.50 to 2.54	9	.....	2	.....	.....	.....	6	1	.....	.....	.....	.....	.....	.....	2.00 to 2.04	14
.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	8	.....	.....	3	4	1	.....	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	15
.....	.....	1	.....	.....	.....	.....	.....	2.50 to 2.54	5	.....	.....	2	1	1	.....	.....	1	.....	.....	.....	.....	.....	1.60 to 1.64	16
.....	.....	.....	.....	.....	.....	.....	.....	1.45 to 1.49	4	.....	.....	.....	.....	4	.....	.....	.....	.....	.....	.....	.....	.....	1.85 to 1.89	17
.....	.....	.....	.....	.....	.....	.....	.....	.....	7	.....	1	.....	3	2	1	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	18
.....	2	.....	.....	1	.....	.....	.....	2.40 to 2.44	33	.....	1	.....	3	4	9	9	6	1	.....	.....	.....	.....	2.15 to 2.19	19
1	.....	.....	.....	.....	.....	.....	.....	1.75 to 1.79	96	2	7	6	18	14	34	2	7	4	.....	2	.....	.....	2.00 to 2.04	20
.....	.....	.....	.....	.....	.....	.....	.....	.....	18	1	.....	5	2	4	4	1	1	.....	.....	.....	.....	.....	1.75 to 1.79	21
.....	.....	.....	.....	.....	.....	.....	.....	.....	9	1	4	1	.....	.....	.....	1	2	.....	.....	.....	.....	.....	1.05 to 1.09	22
1	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	21	1	.....	3	6	.....	10	1	.....	.....	.....	.....	.....	.....	2.00 to 2.04	23
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	24
.....	.....	.....	.....	.....	.....	.....	.....	1.60 to 1.64	9	1	2	1	.....	2	2	.....	.....	.....	.....	.....	1	.....	1.75 to 1.79	25
.....	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	26
.....	.....	.....	.....	.....	.....	.....	.....	.....	4	.....	1	.....	2	.....	.....	.....	1	.....	.....	.....	.....	.....	1.70 to 1.74	27
1	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	26	.....	2	1	10	.....	12	.....	1	.....	.....	.....	.....	.....	2.00 to 2.04	28
1	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	11	7	1	.....	2	1	.....	.....	.....	.....	.....	.....	.....	.....	Less than 1.00	29
.....	1	.....	.....	.....	.....	.....	.....	2.25 to 2.29	2	.....	.....	.....	.....	.....	2	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	30
.....	.....	.....	.....	.....	.....	.....	.....	.....	71	7	3	10	22	8	19	.....	2	.....	.....	.....	.....	.....	1.65 to 1.69	31
.....	.....	.....	.....	.....	.....	.....	.....	.....	2	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	2.25 to 2.29	32
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	33
.....	5	.....	.....	.....	.....	.....	.....	2.25 to 2.29	47	1	3	4	13	1	4	21	.....	.....	.....	.....	.....	.....	2.00 to 2.04	34
.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.40 to 1.44	35
.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	11	8	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Less than 1.00	36
.....	.....	.....	.....	.....	.....	.....	.....	.....	2	1	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	37
2	.....	.....	1	.....	.....	.....	.....	2.00 to 2.04	11	1	2	4	.....	2	2	.....	.....	.....	.....	.....	.....	.....	1.25 to 1.29	38
.....	.....	.....	.....	.....	.....	.....	.....	1.50 to 1.54	13	.....	.....	.....	.....	.....	8	5	.....	.....	.....	.....	.....	.....	2.15 to 2.19	39
.....	.....	.....	.....	.....	.....	.....	.....	1.70 to 1.74	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	40
.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	4	.....	.....	3	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	41
.....	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	8	2	1	2	1	2	.....	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	42
.....	.....	.....	.....	.....	.....	.....	.....	.....	29	.....	.....	.....	.....	1	5	.....	16	.....	.....	.....	.....	.....	2.50 to 2.54	43
2	.....	.....	.....	.....	.....	.....	.....	2.00 to 2.04	11	1	1	.....	9	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.65 to 1.69	44
1	.....	.....	.....	.....	.....	.....	.....	1.30 to 1.34	7	1	2	.....	2	1	.....	.....	.....	.....	.....	.....	.....	1	1.60 to 1.64	45

TABLE 97.—INCOME—CENTRAL ELECTRIC LIGHT AND POWER STATIONS OPERATED BY STREET RAILWAY COMPANIES, BY STATES: 1902.

STATE.	Number of companies.	Gross income.	COMMERCIAL OR PRIVATE LIGHTING.			PUBLIC LIGHTING.			MOTOR SERVICE.	Electric railway service.	Electric heating.	Charging automobiles.	All other electric service.	Miscellaneous.
			Total.	Arc.	Incandescent.	Total.	Arc.	Incandescent.	Amount.					
				Amount.	Amount.		Amount.	Amount.						
United States....	118	$6,469,726	$4,074,684	$660,279	$3,414,405	$1,417,985	$1,267,384	$150,601	$768,040	$6,630	$77	$9	$4,390	$197,911
Alabama	4	318,660	257,454	35,055	222,399	32,712	30,106	2,606	26,345	.....	.....	.....	500	1,649
Florida	3	110,209	84,657	9,441	75,216	11,900	9,660	2,240	13,652	.....	.....	.....	.....	.....
Georgia	7	722,728	421,024	112,940	308,084	173,183	153,503	19,680	119,260	.....	.....	.....	233	9,028
Illinois	4	161,070	118,620	21,929	96,691	6,458	6,458	.....	23,038	395	.....	.....	3,356	9,203
Iowa	8	291,142	154,945	23,586	131,359	75,435	71,515	3,920	40,043	.....	.....	.....	.....	20,719
Maine	3	101,892	67,739	7,978	59,761	11,856	10,904	952	15,141	.....	.....	.....	.....	7,156
Michigan	6	162,549	106,490	9,595	96,895	42,090	36,987	5,103	9,340	.....	.....	.....	.....	4,629
Mississippi	3	98,828	46,232	7,670	38,562	43,547	37,441	6,106	8,982	.....	77	.....	.....	.....
Missouri	3	163,406	138,514	3,533	134,981	10,250	9,920	330	2,240	.....	.....	.....	.....	12,402
New York	10	413,782	243,233	19,969	223,264	140,998	97,988	43,010	28,172	.....	.....	.....	.....	1,379
North Carolina	5	155,770	86,919	6,104	80,815	32,486	30,989	1,497	36,365	.....	.....	.....	.....	.....
Ohio	11	587,967	374,322	45,229	329,093	147,225	143,725	3,500	53,382	.....	.....	.....	.....	13,038
South Carolina	3	171,561	99,128	7,942	91,186	33,993	33,201	792	22,127	.....	.....	.....	.....	16,313
Virginia	7	359,158	261,246	75,248	185,998	65,954	62,441	3,513	28,400	.....	.....	.....	.....	3,558
Washington	4	618,385	439,358	95,182	344,176	44,544	22,948	21,596	76,635	1,795	.....	.....	.....	56,053
West Virginia	3	105,102	67,181	2,975	64,206	36,253	36,253	.....	1,668	.....	.....	.....	.....	.....
Wisconsin	9	689,572	368,540	90,394	278,146	217,277	215,334	1,943	77,166	.....	.....	.....	.....	26,589
All other states[1]	25	1,237,935	739,082	85,509	653,573	291,824	258,011	33,813	186,084	4,440	.....	9	301	16,195

[1] Includes states having less than 3 companies, in order that the operations of individual companies may not be disclosed. These companies are distributed as follows: Arkansas, 2; California, 2; Colorado, 2; Connecticut, 2; Delaware, 1; Indiana, 2; Kansas, 1; Kentucky, 2; Louisiana, 1; Maryland, 1; Minnesota, 1; Montana, 1; Nebraska, 1; New Hampshire, 1; New Jersey, 2; Oregon, 1; Tennessee, 2.

TABLE 98.—ANALYSIS OF SERVICE—CENTRAL ELECTRIC LIGHT AND POWER STATIONS OPERATED BY STREET RAILWAY COMPANIES, BY STATES: 1902.

STATE.	ARC LIGHTING—NUMBER OF LAMPS IN SERVICE.														
	Aggregate.	Total.				Direct current.				Alternating current.				All other.		
		Commercial or private.		Public.		Commercial or private.		Public.		Commercial or private.		Public.		Commercial or private.		Public.
		Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.	Inclosed.	Open.
United States	33,863	2,582	13,603	10,868	6,810	2,413	6,459	10,495	1,072	1	7,069	8	5,738	168	75	365
Alabama	1,291	449	442	325	75	449	388	325	.....	.....	54	.....	75	.....	.....	.....
Florida	222	103	55	.....	64	103	.....	.....	.....	.....	55	.....	64	.....	.....	.....
Georgia	4,347	238	2,092	761	1,256	238	1,294	761	238	.....	798	.....	1,018	.....	.....	.....
Illinois	817	235	328	.....	254	235	295	.....	254	.....	33	.....	.....	.....	.....	.....
Iowa	1,603	133	388	812	270	133	84	812	40	.....	304	.....	230	.....	.....	.....
Maine	431	25	230	115	61	25	115	115	30	.....	115	.....	31	.....	.....	.....
Michigan	869	30	286	352	201	30	36	352	.....	.....	250	.....	201	.....	.....	.....
Mississippi	477	.....	112	132	233	.....	.....	132	.....	.....	112	.....	233	.....	.....	.....
Missouri	203	37	5	111	50	37	.....	111	.....	.....	5	.....	50	.....	.....	.....
New York	2,594	56	1,070	964	504	55	65	964	.....	1	1,005	.....	504	.....	.....	.....
North Carolina	613	12	174	325	102	12	.....	325	.....	.....	174	.....	102	.....	.....	.....
Ohio	2,933	24	518	1,838	553	24	90	1,838	.....	.....	353	.....	553	.....	75	.....
South Carolina	693	.....	236	.....	457	.....	37	.....	198	.....	199	.....	259	.....	.....	.....
Virginia	2,963	219	1,710	757	297	219	933	757	100	.....	777	.....	197	.....	.....	.....
Washington	1,854	116	1,416	19	303	116	1,263	19	121	.....	153	.....	182	.....	.....	.....
West Virginia	572	.....	70	75	427	.....	.....	75	.....	.....	70	.....	427	.....	.....	.....
Wisconsin	4,715	387	1,778	1,871	679	387	1,277	1,871	91	.....	501	.....	588	.....	.....	.....
All other states[1]	6,646	518	2,693	2,411	1,024	350	582	2,038	.....	.....	2,111	8	1,024	168	.....	365

[1] Includes states having less than 3 companies, in order that the operations of individual companies may not be disclosed. These companies are distributed as follows: Arkansas, 2; California, 2; Colorado, 2; Connecticut, 2; Delaware, 1; Indiana, 2; Kansas, 1; Kentucky, 2; Louisiana, 1; Maryland, 1; Minnesota, 1; Montana, 1; Nebraska, 1; New Hampshire, 1; New Jersey, 2; Oregon, 1; Tennessee, 2.

TABLE 98.—ANALYSIS OF SERVICE—CENTRAL ELECTRIC LIGHT AND POWER STATIONS OPERATED BY STREET RAILWAY COMPANIES, BY STATES: 1902—Continued.

STATE.	INCANDESCENT LIGHTING—NUMBER OF LAMPS IN SERVICE.									STATIONARY MOTOR SERVICE.		Number of mechanical meters on consumption circuits.
	Aggregate.	Total.		16-candlepower.		32-candlepower.		All other.		Number of motors of all kinds.	Total capacity in horsepower.	
		Commercial or private.	Public.	Commercial or private.	Public.	Commercial or private.	Public.	Commercial or private.	Public.			
United States	1,442,685	1,423,659	19,026	1,313,303	13,065	31,597	1,119	78,759	4,842	10,049	35,688	[1]56,601
Alabama	50,704	50,045	659	47,705	659	2,203	.....	137	.....	648	936	2,606
Florida	19,872	19,541	331	19,408	323	127	8	6	.....	137	714	880
Georgia	136,978	135,604	1,374	132,630	900	1,470	30	1,504	444	2,066	4,844	5,121
Illinois	42,426	42,426	.....	37,883	.....	226	.....	4,317	.....	202	611	1,475
Iowa	62,284	61,924	360	57,610	60	1,830	50	2,484	250	549	1,479	3,338
Maine	39,443	39,379	64	38,079	.....	300	39	1,000	25	129	1,011	1,139
Michigan	43,389	41,169	2,220	36,577	2,130	1,134	90	3,458	.....	136	700	1,857
Mississippi	12,887	11,890	997	11,290	997	100	.....	500	.....	295	198	714
Missouri	66,130	66,075	55	45,000	50	75	5	21,000	.....	87	119	1,558
New York	100,561	98,812	1,749	86,950	691	2,257	47	9,605	1,011	336	2,662	[1]6,217
North Carolina	31,742	31,498	244	28,132	204	423	40	2,943	.....	105	1,544	1,273
Ohio	189,708	188,065	1,643	186,683	1,613	682	20	700	10	513	3,589	5,813
South Carolina	24,225	24,117	108	23,517	100	600	.....	.....	8	689	618	1,270
Virginia	65,148	64,815	333	52,595	328	2,224	5	9,996	.....	1,960	1,467	3,100
Washington	93,247	90,483	2,764	70,667	205	10,828	35	8,988	2,524	587	3,720	4,838
West Virginia	23,294	23,294	.....	20,984	.....	1,647	.....	663	.....	28	121	770
Wisconsin	180,073	179,611	462	170,305	337	3,646	125	5,660	.....	87	3,711	5,403
All other states	260,574	254,911	5,663	247,288	4,468	1,825	625	5,798	570	1,495	7,644	9,234

[1] Includes 82 chemical.

APPENDICES

APPENDIX A.—SCHEDULE

APPENDIX B.—INSTRUCTIONS TO SPECIAL AGENTS

APPENDIX A.

SCHEDULE.

Name of company .....
State.....City.....
General offices at .....

UNITED STATES CENSUS OFFICE,
Washington, D. C., October 15, 1902.

By section 7 of the Act of Congress for the establishment of a permanent Census Office, passed March 6, 1902, the Director of the Census is required to prepare a report on electric light and power of the United States, and the following schedule has been formulated for that purpose.

Mr. Thomas Commerford Martin, of New York city, expert special agent, is in charge of the electric branch of this inquiry.

The information returned on this schedule should cover the business year of the establishment most nearly conforming to the year ending June 30, 1902. All questions that require a fixed time, such as cash on hand, etc., should be of the date of the last day of the year covered by the report.

WILLIAM R. MERRIAM,
Director of the Census.

Extract from Act of Congress, March 3, 1899:

SECTION 22. * * * "And every president, treasurer, secretary, director, agent, or other officer of every corporation, and every establishment of productive industry, whether conducted as a corporate body, limited liability company, or by private individuals, from which answers to any of the schedules, inquiries, or statistical interrogatories provided for by this Act are herein required, who shall, if thereto requested by the Director, supervisor, enumerator, or special agent, willfully neglect or refuse to give true and complete answers to any inquiries authorized by this Act, or shall willfully give false information, shall be guilty of a misdemeanor, and upon conviction thereof shall be fined not exceeding ten thousand dollars, to which may be added imprisonment for a period not exceeding one year."

CERTIFICATE.

This is to certify that the information contained in this schedule is complete and correct to the best of my knowledge and belief, and it covers the period from....., 190.., to....., 190...

.....
(Signature and official designation of the person furnishing the information.)

.....
(Signature of Special Agent.)

1. Date when this establishment commenced operations.....
2. Character of original organization, whether individual, corporation, municipal, or other form .....
3. Date and character of subsequent changes in ownership or organization....
4. If a consolidated company, give names of constituent companies and dates of consolidation .....
5. If a reorganized company, give name of original company and date of reorganization.....
6. If a subsidiary or leased company, give name and address of controlling company or lessor and date such control began or date of lease.....
7. Character of service (answer yes or no):
   Arc lighting.....; commercial or other private.....; streets and other public places.....
   Incandescent lighting.....; commercial or other private.....; streets and other public places.....
   Motor power.....; stationary.....; electric railway.....
   Other service (state kind).....
8. If the corporation or firm is engaged in any business or industry other than that of central station work for electric light or power, state the character of such business or industry, and if conducted in the same or separate plants .....
9. Franchise conditions:
   State the franchise rights under which the company or firm operates, whether charter .....; special act of the state legislature .....; municipal ordinance .....; or by other authority (state kind).....
   Exclusive or competitive franchise .....
   Terms of franchise, if limited as to time or perpetual; if limited, state number of years .....
   What free service, if any, is required as a condition of the franchise .....
   Compensation required for the franchise; form and amount, if any .....

10. CAPITAL STOCK, BONDS, AND DIVIDENDS.

	Number of shares or bonds.	Total par value.
Authorized capitalization—		
Common stock		$.....
Preferred stock		
Bonds		
Capital stock and bonds issued—		
Common stock		
Preferred stock		
Bonds		

Dividends and interest, if any, paid during the year—
Common stock, rate.....; amount $.....
Preferred stock, rate.....; amount $.....
Bonds, rate.....; amount $.....

11. COST OF PLANT.

	Cost during the year.	Cost to date.
Land	$.....	$.....
Buildings		
Machinery, tools, and implements within stations		
Overhead electric service construction		
Underground electric service construction		
Lamps, motors, meters, and transformers, wired for use		
Supplies of every description on hand not enumerated in the foregoing items.		
Miscellaneous		
Total		

12. EMPLOYEES, SALARIES, WAGES, ETC.

CLASSES.	Average number employed during the year.	Total amount paid in wages or salaries during the year.
General officers		$.....
Other officers (managers, superintendents, etc.)		
Clerks		
Foremen		
Inspectors		
Engineers		
Firemen		
Dynamo and switchboard men		
Linemen, etc		
Mechanics		
Lamp trimmers		
Other employees		
Total		

Number of employees at specified daily rates of pay.

DAILY RATES OF PAY.	Foremen.	Inspectors.	Engineers.	Firemen.	Dynamo and switchboard men.	Linemen, etc.	Mechanics.	Lamp trimmers.
$0.75								
$1.00								
$1.25								
$1.50								
$1.75								
$2.00								
$2.25								
$2.50								
$2.75								
$3.00								
$3.25								
$3.50								
$3.75								
$4.00								
$4.25								
$4.50								

OTHER DAILY RATES OF PAY.	Foremen.	Inspectors.	Engineers.	Firemen.	Dynamo and switchboard men.	Linemen, etc.	Mechanics.	Lamp trimmers.

RATES OF PAY PER HOUR FOR OVERTIME.

13. MISCELLANEOUS EXPENSES.

	Amount.
Rent of stations and line wire supports, conduits, or underground privileges	$
Rent of offices	
Taxes	
Injuries and damages	
Insurance	
Ordinary repairs of buildings, machinery, etc	
Amount paid for interest, advertising, office supplies, law expenses, telegraph and telephone service, and all other sundries not reported elsewhere	
Total	

14. SUPPLIES AND MATERIALS PURCHASED FOR USE DURING THE YEAR.

KINDS.	Unit of measure.	Quantities.	Cost, not including freight.
Supplies:			
Meters			$
Motors			
Transformers			
Incandescent lamps			
Incandescent lamp fittings, sockets, etc			
Carbons for arc lamps			
Globes for arc lamps			
Hoods, etc., for arc lamps			
Arc lamp repairs			
Poles or other supports			
Wire and cable			
All other supplies (not to include oil, waste, etc.)			

14. SUPPLIES AND MATERIALS PURCHASED FOR USE DURING THE YEAR—Continued.

KINDS.	Unit of measure.	Quantities.	Cost, not including freight.
Fuel:			
Coal			$
Crude petroleum			
Natural gas			
Artificial gas			
Other fuel (state kind)			
Water			
Mill supplies (oil, waste, etc.)			
All other materials			
Rent of waterpower			
Total cost			

Amount of freight, if any, paid on the above .....

15. INCOME.

SOURCE.	Amount.
Lighting:	
Commercial or private	$
Public	
Motor service	
Electric railway service	
Electric heating	
Charging automobiles	
All other sources	
Total income	

Total income for preceding business year .....

16. POWER PLANT EQUIPMENT.

GENERATING POWER PLANT.	Number.	Total capacity in horsepower.
1. Steam engines: 500 horsepower and under		
Over 500 horsepower and under 1,000 horsepower		
1,000 horsepower and under 2,000 horsepower		
2,000 horsepower and over		
2. Water wheels: 500 horsepower and under		
Over 500 horsepower and under 1,000 horsepower		
1,000 horsepower and under 2,000 horsepower		
2,000 horsepower and over		
3. Gas engines		
4. Boilers		
5. Auxiliary engines for use within plant as accessories, etc.		

Power supplied by other establishments, if any, kind ..... Horsepower.....; name and address of establishment supplying the same .....

17. ELECTRIC GENERATING PLANT.

CLASSES.	Number.	Total capacity in horsepower.	Voltage.
Dynamos: Direct current, constant voltage			
Direct current, constant amperage			
Alternating and polyphase current: Number of phases			
Boosters			
Rotaries			

18. State the number of hours of operation per day, if day circuits are not operated .....

19. OUTPUT OF STATION.

Kilowatt hour, average per day .....

Kilowatt hour, total for year .....

Horsepower of current, average per day .....

Horsepower of current, total for year .....

20. LINE CONSTRUCTION.

CLASSES.	AGGREGATE LENGTH IN MILES.	
	Mains.	Feeders.
Lighting and stationary motor service: Underground		
Overhead		
Submarine		
Total		
Electric railway car service owned by lighting company, if any: Underground		
Overhead		
Total		

21. Storage batteries in main power plant:
Number of cells .....; total capacity in horsepower.....
Total ampere hour capacity at 5-hour rate of discharge.....

22. SUBSTATION PLANT.

	Number.	Total capacity in horsepower.
Storage battery cells		
Total ampere hour capacity at 5-hour rate of discharge		
Transformers		
Rotary converters		
Miscellaneous		

23. Transformers: Number in circuit for customers .....; total capacity in horsepower .....

24. ARC LIGHTING.

	Type of lamp.	NUMBER IN SERVICE.		
		Total.	Public.	Commercial or private.
Direct current	Open			
	Inclosed			
Alternating current	Open			
	Inclosed			
All other	Open			
	Inclosed			
Total	Open			
	Inclosed			

Total income for the year from arc lighting:
Commercial or private service ..... $.....
Public service ..... $.....

25. INCANDESCENT LIGHTING.

	NUMBER IN SERVICE.		
	Total.	Public.	Commercial or private.
Capacity of lamp: 16 candlepower			
32 candlepower			
All other			

Total income for the year from incandescent lighting:
Commercial or private service ..... $.....
Public service ..... $.....

26. Stationary motor service:
Number of motors of all kinds .....
Total capacity in horsepower .....
Income from motor service ..... $.....

27. Railway motor car service, prices of current to users:
Price charged per kilowatt hour, indicated at station ..... $.....
Price charged per car mile ..... $.....
Price charged per car per day ..... $.....
Additional price per car mile for trail cars ..... $.....
Total income for the year from motor car service ..... $.....
Number of railway motor cars served ..... $.....

28. Other electric service, prices of current to users:
Character of service .....
Total income for the year derived from such service ..... $.....

29. METERS ON CONSUMPTION CIRCUITS.

	Number.
Mechanical	
Chemical	
All other	

Proportion of service given by meter rates .....

APPENDIX B.

INSTRUCTIONS TO SPECIAL AGENTS.

Reports must be secured on Special Schedule No. 2 (Form 8–122) for all electric plants doing a public service business—that is, all plants, whether owned or operated by individuals, companies, corporations, or municipalities, established for the purpose of generating electric current for sale, that were in existence during any portion of the year ending June 30, 1902.

Isolated plants doing incidentally a central station business and deriving revenue from the sale of electric current must be reported. No report, however, is required for isolated plants operated for the exclusive benefit of the owner.

Each agent will be furnished with a list giving the names and addresses of all central electric plants in the territory assigned him, which were in existence or building during the year ending June 30, 1902. This list has been prepared from technical journals, electrical directories, etc., and, therefore, can not be accepted as complete. The agents must be constantly on the alert to discover other plants. They must make careful inquiry at each city and town they visit for electric plants located in that vicinity. If such plants are discovered and they are located in the territory assigned the agent, he should proceed to secure returns for them under the same conditions that reports are secured from other plants. In forwarding the reports for new plants, the agent must call attention to the fact that the name of the plant does not appear on the list furnished him.

In some instances the companies named on the office list had not commenced the actual construction of the plant at the time the list was prepared. Such establishments are designated as "proposed." No returns are to be secured for establishments of this character, unless the plant has since been constructed, and where this is the only establishment located in a place, the agent will not be required to visit that place for the purpose of securing the report. The names of proposed establishments are given so as to enable the agent to have in his possession all of the obtainable information concerning electric plants located in his territory.

The agent is required to visit the different cities and towns in the order in which they are named on the list, unless he finds that railroad connections and local conditions make a change necessary. In such cases, the conditions and character of the change must be given on the agent's daily report.

In all cases where an annual report of the plant is printed, a copy of the latest report should be secured and forwarded with the schedule. Copies should also be returned of the latest reports of the directors or officers of the plant, or other printed matter that would add to the information contained in the schedule.

In case an electric plant is owned by a company with an office in another locality, outside the territory of the agent, and it is impossible to secure a complete report at the plant, the agent should complete the schedule as far as possible from the data obtainable, and forward it to the Census Office with a full statement of the facts, giving also the names and addresses of the persons from whom further information may be obtained.

All entries in the schedule must be made clearly and neatly in ink. Amounts and values must be obtained from book accounts, if such accounts are available. Each question is to be answered. If any question is found not applicable and no amounts are reported, write the word "None."

An exact answer to each item enumerated in the several questions is what is required, and is what should be given if it can be secured with a reasonable amount of labor. It is anticipated, however, that in a number of plants the accounts are not kept under just such a series of items as has been enumerated. If a general account is kept for two or more different services, the expenses should be equitably apportioned among such services. If the accounts cover two or more of the items enumerated for any of the inquiries, a similar proportion should be obtained for the reply to each. In all cases where the answers are estimated, the amounts must be preceded by the word "Estimate."

The cover of the schedule must be left blank, as the name of the establishment is to be supplied after the receipt of the report at the Census Office.

Central electric stations are sometimes operated in connection with other industries such as waterworks, gas works, manufacturing, mining, or street railways. In such cases a specific statement of the facts must be made in answer to Inquiry 8. If the system of accounts used by the company will permit of the preparation of a separate report for the electric light and power plant, a separate return should be obtained; but, if in such case the power plant is conducted in connection with a street railway, and the system of accounts will not permit of the preparation of separate returns, a report should be secured for the entire plant on the schedule for street railways (Form 8–120), and a report must also be secured on the schedule for electric light and power (Form 8–122), answers being given to questions 1 to 9, inclusive, and 15 to 29, inclusive, or such of them as are applicable to the plant reported.

In cases where the electric plant is operated in connection with any business other than that of street railways and the system of accounts will not permit of the preparation of a separate return, careful estimate must be prepared for answer to all the questions contained in the schedule (Form 8–122); these estimates must be prepared by, or submitted to and approved by, the person furnishing the information. The items of capital, employees, wages, cost of materials and supplies, miscellaneous expenses, and income, must pertain only to the electric light and power station.

In cases where two or more central power plants are owned by one individual, company, or corporation, and located in the same city or town, separate reports should be secured for each plant if the systems of accounts will permit of the preparation of separate returns. Otherwise, one schedule may be made to cover the operation of all the plants, but in such cases the number of separate plants included in the report should be stated in answer to Inquiry 4.

Give, on page 1, the name, location, street and number, and post office address of the establishment, and obtain the signature and official designation of the person furnishing the information. The period covered by the report must be shown in the certificate. If the address of the general or business office is at a different place from that of the plant, give both.

INQUIRY 1.—DATE WHEN THIS ESTABLISHMENT COMMENCED OPERATIONS.

Give the date, if obtainable, when the original establishment commenced operations, which will not necessarily be the date when the present owners assumed control.

INQUIRIES 2 TO 6, INCLUSIVE.

These are intended to obtain information concerning the character of the organization under which the company is operated, and the date and character of the changes in such organization. The answers given to each of these questions must be consistent.

INQUIRY 7.—CHARACTER OF SERVICE.

By commercial service is meant the service to business houses, hotels, office buildings, etc.; private service relates to residences. By public service is meant the service for all public uses, and for which the municipality or other government pays, such as the lighting of streets, parks, municipal buildings, etc. Lights in front of buildings or stores, when paid for by the owner or tenant, must be considered as "commercial or other private" service. The inquiries are to be answered by "Yes" or "No."

INQUIRY 9.—FRANCHISE CONDITIONS.

For the purpose of this investigation the word "franchise" is understood to mean any legislative permit giving authority for the carrying of lines of wire over or under, along or across, the streets of the municipality, or any legislative or official permit necessary to the establishment of the company. If the company is organized under a general act of the legislature, the date of the passage of such act should be given. In such cases give also the date and character of the municipal ordinances or other privilege which may have been granted the company. The answer to the first section of this inquiry will be "Yes" or "No." A competitive franchise is one that permits the granting of a franchise to another company to occupy the same territory for the same purpose. Describe the terms of the franchise in a separate memorandum, which must be attached to the schedule. If free service is required as a condition of the franchise, it should be described and an estimate given of the amount that would be received for corresponding service, if paid for.

INQUIRY 10.—CAPITAL STOCK, BONDS, AND DIVIDENDS.

Account for the entire amount of common, preferred stock, and bonds, respectively, authorized, the amount of each issued up to the end of the year for which the report was made, giving the number of each class, the par value, and the full amount of dividends paid during the year.

INQUIRY 11.—COST OF PLANT.

The answer to this inquiry must show the total cost of the plant up to the end of the fiscal year for which the schedule is made, with a separate statement of the cost of additions and extensions during the year. The cost must include all expenses incident to the organization of the company and the establishment of the plant. If the accounts are not kept so as to show the cost of each item named under the inquiry, ascertain the total cost and apportion this among the several items according to the best judgment of the person furnishing the information. If the total or any of the items are estimated, they should be marked with the word "Estimate." Amounts paid, if any, for the franchise should be included under "miscellaneous." If land was donated, that fact should be stated and the estimated value at the time of the donation given.

INQUIRY 12.—EMPLOYEES, SALARIES, WAGES, ETC.

Account for all persons employed by the company, both in the management and in the operation of the plant. Give the number of officers who receive salaries (not the number of stockholders), and the gross amount of their salaries. Report separately the number and wages of dynamo men, linemen, and other classes of employees specified. The salaries and wages should include board or rent furnished as part compensation. The average number employed during the year is the number that would have continuous employment for the 12 months. There should be no difficulty in securing this information for the plant of ordinary size, but it may be that the large companies keep an itemized pay roll, the total only being carried forward from each week or month. In such cases it will be necessary to either add the pay roll of each week or month, for each class of employees, or compute the aggregate for each class, using a pay roll for a representative week or month, as the base. Results obtained by the latter method will be accepted.

Number of employees at specified daily rates of pay.—This inquiry is designed to ascertain the number of employees for each of the 8 classes enumerated that receive the daily rates of pay specified. If there are other daily rates, enumerate them and give the number employed at each, also give the hour rates for overtime for each of the 8 classes.

INQUIRY 13.—MISCELLANEOUS EXPENSES.

All items of expense incident to the business for the year and not included in answer to Inquiries 12 and 14 must be reported here. Do not include any portion of the freight reported under Inquiry 14 as paid on materials and supplies. Expenses incident to additions or extensions of the plant or line should not be included in answer to Inquiries 12, 13, or 14. The cost of such additions must be reported as cost of plant—Inquiry 11.

INQUIRY 14.—SUPPLIES AND MATERIALS PURCHASED FOR USE DURING THE YEAR.

The actual cost of all materials and supplies must be reported. Give the cost, exclusive of freight charges, and then the total freight paid. If this is not practicable, give the cost including the freight charges, and state that such charges are included. In answering this inquiry report only the materials and supplies that were used for ordinary repairs or replacement during the year reported. Expenditures for additions to the plant, such as new machinery, additional lines on which new meters, motors, or transformers, or lamps are installed, should be included in answer to Inquiry 11—Cost of Plant. Quantities should be given when possible, and the unit of measure stated, as "number," "pounds," "tons," "feet," etc. Opposite "mill supplies" give the cost of oil, waste, and other supplies consumed in the running of machinery. If large quantities of fuel were purchased with a view of taking advantage of low prices, that fact must be stated in a footnote, and the total quantity and its value given; but in such case, the answer to the inquiry should be the quantity consumed during the year.

INQUIRY 15.—INCOME.

The total amount of income indicated by the books of the company for the entire year should be reported. Give separate amounts for the different sources indicated. Give also the total income for the preceding business year.

INQUIRY 16.—POWER PLANT EQUIPMENT.

These are details that should in every instance be readily obtainable. If the manager or superintendent does not know the capacity of his boilers, he will probably know that of his engine or of his dynamo, and all are closely related. The boiler capacity is almost invariably installed larger than the engine requires, and the engine has always a margin of more power than the dynamo calls for. Thus, a dynamo of 150 horsepower may be driven by an engine of 175 horsepower, and the engine may be supplied with steam from a boiler that can furnish 200 horsepower. "Auxiliary engines" will sometimes be found in small plants, but in the larger plants they or electric motors are in common use to drive pumps, etc., and the superintendent or manager can readily enumerate them.

INQUIRY 17.—ELECTRIC GENERATING PLANT.

Direct current constant voltage dynamos or generators are used chiefly for incandescent lighting and for motor service. Voltage means *pressure or force*. The requirement for this service is a current of low but constant *pressure or force* of current in one direction. The *amperage* of the current, or the quantity, is usually large and may be variable.

Direct current constant amperage generators are used chiefly for arc lighting. The requirement for this service is usually a current of small but continued quantity in one direction. The voltage of the current from such machines is usually very high.

Polyphase current or alternating current generators are used chiefly for long distance distribution. Alternating current flows alternately in opposite directions and is rapidly reversed. The current is sent over the primary lines at a very high voltage and is modified by passing through a "transformer," to be reduced to a safe pressure before being applied to the practical work of operating lamps, motors, or other devices. A transformer of some kind is almost always used with an alternating current. Polyphase alternating currents are now coming into use, and hence the machines which are not single phase alternating will be either two phase or three phase. If the current delivered to the customer from these machines is to be "direct current," it passes through "rotary converters," as well as through the "transformers." (See Inquiry 23.)

INQUIRY 18.—HOURS OF OPERATION.

The object of this inquiry is to ascertain the number of hours each day that the station is in operation. If day circuits are operated the presumption is that the station is in operation during the entire day of twenty-four hours. A great many of the small stations are likely to be found, however, which are run only at night, for lighting purposes, and which have no "day load" of motors, street cars, etc., requiring current during daylight hours. Hence the plant stands idle except during the hours of lighting.

INQUIRY 19.—OUTPUT OF STATION.

This is an inquiry in regard to which some plants may have no data, although in many of them it is a matter of careful scientific accounting. In every case the volts multiplied by the amperes will give the number of watts. A kilowatt is 1,000 watts. There are 746 watts in the old familiar horsepower, so that a kilowatt is roughly 1⅓ horsepower. Watt hours are the product of watts multiplied by the number of hours during which the current is in use. Thus, a power house with a dynamo delivering current to the line of 1,000 amperes at 550 volts pressure is generating 550,000 watts, or 550 kilowatts. If these 550,000 watts are furnished on an average twenty hours daily, we get 11,000,000 watt hours, or 11,000 kilowatt hours. The total for the year can be arrived at from the daily total, and the horsepower of current can be figured from the kilowattage, or vice versa, by the simple calculation above given.

INQUIRY 20.—LINE CONSTRUCTION.

A main wire is one leading from the feeder wires, covering the area over which the service is distributed. A feeder wire is one leading from the generating plant to a point some distance from the station, where it is connected with the main wires. Its purpose is to supply the current to the main wires, drawn off by service wires, so there may be a number of feeder wires, one reaching beyond another. A service wire is one connecting the main wire with lamps, motors, or other devices to be operated.

In the case of "electric railway car service" a few instances may be found where the lighting company supplying electric current for the operation of the railway owns some or all of the main and feeder wires. Generally, however, it will be found that these wires are owned by the railway company. In that event no account should be taken of them in giving data for the lighting company.

Underground conduits are generally owned by the lighting companies. There are, however, a few instances in which they are owned by an underground conduit company, or by the municipality. In these cases the lighting company hires the use of ducts through which its mains and feeders are drawn. In such cases the amounts paid out for this accommodation by the lighting companies form an important factor in determining the price to be charged for the service. It is required, therefore, that a complete statement be obtained from lighting companies paying rent for underground conduits, showing all the conditions and charges imposed upon them by the owners of the conduits. If there is not sufficient space allowed in the schedule to state the facts fully and clearly, an extra sheet of paper may be used and pinned to the schedule.

INQUIRIES 21 AND 22.—STORAGE BATTERIES—SUBSTATION PLANT.

The object of these inquiries as to batteries is to ascertain the number of hours each day that the battery is available. An ampere is an electric unit of quantity. The volume of an electric current is always stated in amperes, so that an ampere hour is one ampere of current supplied for one hour. Storage batteries, which consist of sets of lead plates in a solution of sulphuric acid, are usually rated by their five-hour discharge of the current stored in them, and hence their output is spoken of in terms of ampere hour capacity at the five-hour rate of discharge, and also in terms of horsepower capacity. The current, like water from a tank, might all be drawn out in one hour, or its supply, taken off occasionally in smaller quantities, might be made to last for weeks; hence the desirability of the adoption of the five-hour rating as a standard period during which the battery is in service to return the available quantity of the current with which it was charged as a reservoir by the generating plant. Storage batteries are used in the main stations and frequently in substations. The part they play is as important as that of the gasometer in the gas industry. While some equipments are very large, others are quite small. The agent is desired to obtain a concise and clear statement as to the factors, economic and otherwise, involved in their use and operation. Governors and other machines used in connection with the generation or distribution of the current should be reported under "miscellaneous," Inquiry 22. In this inquiry "storage battery" means each "cell," and each station battery will usually contain a number of cells, say from 50 or 75 upward.

INQUIRY 23.—TRANSFORMERS.

A great deal of electric work in scattered communities is done with the aid of transformers, which are also to be found in some of the larger cities at the customer's end of the line, although as a general thing in large city plants it is the practice to furnish direct current to the consumer, in which case transformers are not needed outside the station or substation. Where the lamps in a customer's house or store are fed with alternating current, the transformers are placed on an adjacent pole or in a cellar or other room where they are not free of access, as the primary voltage is dangerous to life. The current is sent out at a high pressure from the central station to them, and is received by the primary coil in the transformer at, say, 1,000 or 2,000 volts. The secondary coil takes the small quantity high pressure current from the primary coil, and transforms it into large quantity low pressure current for use in the lamps, motors, etc. The coils and the iron core they surround are inclosed in water-tight metal boxes, and they present, roughly, a resemblance to mail boxes and fire alarm boxes.

INQUIRY 24.—ARC LIGHTING.

Open arc electric lamps are usually employed in street lighting, and are those having the pair or two pairs of carbons inclosed in a single large globe. They are designed to burn a small number of hours (ten to fifteen) before having the carbon renewed. An inclosed arc lamp has two globes, a large or outer one inclosing a

small one in which the single pair of carbons is incased, and is designed to burn a large number of hours (one hundred to one hundred and fifty) before having the carbons renewed. Both kinds may be either of the direct current or of the alternating current type.

For number of each type of lamp in service give the number connected or wired ready to render service, and not the number actually performing service at any one time. The statement should show how many lamps are in position to render service, and therefore to earn an income.

Give total amount received for commercial or private service and public service, respectively. If the incandescent and arc lamps are connected on the same meter, and it is found impossible to separate the income, the total income for both classes of service should be ascertained and a careful estimate made for the separate income, the income from the incandescent service being reported in answer to Inquiry 25. The total for both classes of service will be given in answer to Inquiry 15. This public service is the lighting of streets, parks, public buildings, and all other public places for the illumination of which the municipality or other government is responsible. Public lighting contracts are usually made for a term of years. The customary contract is based on what is known as a lighting schedule. Two principal schedules, which show the extremes, are designated by business men, respectively, as the "all-night-and-every-night schedule," estimated at 4,000 hours per year, and the "dark-of-moon, every night, one-hour-after-sunset-until-12-o'clock-midnight schedule," estimated at 1,200 hours per year. Between these extremes are numberless variations. The income received from public service, therefore, can be very easily ascertained. If this income for arc lighting and incandescent lighting is not shown separately, the separation should be estimated in the same manner as indicated for arc lighting and incandescent lighting.

Inquiry 25.—Incandescent Lighting.

The total number of the different varieties of incandescent lamps used for public and private service, respectively, should be reported. If the exact number can not be ascertained, a careful estimate will be accepted. Such lamps are almost invariably of the 16-candlepower type, although some 32-candlepower and others of larger illuminating power are in general use. Smaller candlepower lamps are also used for sign and decorative purposes.

Inquiry 26.—Stationary Motor Service.

This term is applied by central station men to electric motors that are permanently located at one point, as distinguished from electric railway motors on cars. Such stationary motors will include an infinite variety of work, and in many cases the companies will have difficulty in reporting the number of motors on their circuits, or in giving the separate income from motors, especially where current is furnished through meters. But the inquiry must be pushed, and where exact figures can not be given from records, it is desirable that a close estimate be secured. These stationary motors will include every class of industrial work and many other varieties of application, such as fans, elevators, etc. It is a custom of many companies to make special rates for what they call "power" business, as distinct from that done in supplying current for lamps; and where this is the case, their records should show the data as to motor service and income.

Inquiry 27.—Railway Motor Car Service.

Several instances will be found in which an electric lighting company is supplying current to an electric railway company. It is believed that usually the main and feeder wires for the current are owned by the latter; but sometimes they are owned by the former, in which case the lighting company should be credited with them (see Inquiry 20). If the street railway company is the owner, these wires will be included in the separate return for that company. The facts in the case can be ascertained by a simple question on the subject.

In many instances the lighting and street railway properties are owned and operated by one company. Sometimes the lighting plant or the street railway system is operated under a lease. The separate lighting and street railway forms provide for such a contingency.

The terms upon which electric light plants furnish current for cars are various, but it is believed that all are provided for in the inquiry. It will be seen that one method is that of charging for the actual current used as shown by the meter. In this case the lighting company will have official records showing the consumption.. It would seem that in the other instances of charges per car per day, or per car mile, a system of averages will prevail, and the special agent must endeavor to secure an intelligent report on this point. In all cases the amount of income must be secured from the books of the company, even if the other figures require estimating or are deduced from the other items.

Inquiry 28.—Other Electric Service.

The great bulk of the work done by an electric lighting company consists in furnishing current for light and power; but there are other uses, for some of which special prices are often made. These uses will include electro-chemical, electro-metallurgical, electroplating, electric welding, electric heating, and other branches. This inquiry will develop many interesting local peculiarities of demand and supply, in regard to which the fullest information is sought.

Inquiry 29.—Meters on Consumption Circuits.

This inquiry has nothing to do with the meters installed at the central station, and applies solely to meters installed on the consumer's premises, just as gas meters are. For the purposes of this investigation, the meters have been divided into two broad, main classes; one mechanical, the other chemical. In the former, the current actuates, electro-mechanically, an escapement or train of gear wheels, and registration is effected. In the chemical class, a deposit of metal is usually effected in a cell by the action of the current and the amount of current used is ascertained by measuring or weighing the metal deposited, month by month. These meters are also called "electrolytic." It is believed that most of the instruments found on consumers' premises will be of what is known as the "recording wattmeter" type. These should be counted as mechanical meters. Edison meters, so called, are of the chemical electrolytic type, but a great many Edison companies either do not use them or else use large numbers of the mechanical meters as well.

MUNICIPAL PLANTS.

Schedule No. 2 (Form 8–122) is prepared for plants owned by individuals, companies, or corporations. In applying this schedule to plants owned and operated by municipalities, certain changes will be necessary. These changes should be made by the agent, and additional information, when required, must be given on a separate sheet of paper and securely fastened to the schedule. It will often occur that the administration of a municipal plant is assigned to a public officer or officers performing other duties, or that a part or all of the labor of collecting and accounting is done in the office of some other department—waterworks, for example. In such a case this should be stated and a fair proportion of the salary of the officer and of the office expenses where this work is

done should be entered on the schedule and considered as the expense of the electric plant.

Inquiry 11.—Cost of Plant.

The installation of municipal plants is frequently attended by a preliminary cost for expert reports, engineering plans, specifications, printing, advertising, holding a special election, traveling inspection by a special committee, etc., which would not, under ordinary circumstances, be included in the cost of the plant. Care must be taken in all cases of this character to attach a memorandum to the schedule giving the answers to the following questions:

Preliminary cost of plant:

Engineering plans, specifications, and information	$.....
Printing, advertising, and legislation	.....
Holding special election or additional cost of general election	.....

Inquiry 12.—Salaries, Wages, etc.

If a general account is kept for two or more different services, such as water, streets, etc., the expenses for the electric plant should be equitably apportioned among such services. The following plan is suggested to aid in arriving at an equitable apportionment of the salaries, wages, and miscellaneous expenses: For officers, clerks, and all employees, charge to each service such a part of the total amount paid as the time devoted to that service is a part of the whole time worked; for rent and all sundry office expenses, in proportion to the income of each service; for insurance, taxes, law, depreciation, interest on bonds or floating debt, and all contingent expenses, in proportion to the amount of investment; for fuel, water, and all other power expenses, in proportion to the horsepower utilized by each service.

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